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Developing safety culture interventions in the manufacturing sector

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Developing Safety Culture Interventions in the Manufacturing Sector

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List of Conference Presentations

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Nazaruk, M., Weyman, A., & Hellier, E. (2008). *Changing minds. Developing effective safety culture interventions*. Paper presented at the First GWR Research Symposium, Bristol, UK.

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Abstract

This thesis offers a commentary on the use of an embedded approach to explore variables impacting on employee safety culture at a large manufacturing plant. A mixed method approach was adopted in order to assess the safety culture of the company. The assessment stage consisted of point-of- work observations; unstructured individual interviews, semi-structured focus groups and a safety culture survey. This afforded a detailed insight into a rich array of context-specific variables impacting on employee perceptions of safety in the company, referenced to leadership style, incident reporting, rule breaking / risk taking, time pressure, communication and reactive approach to addressing safety issues.

The safety culture assessment was followed by the development and implementation of two safety culture improvement programmes (interventions). Two matched pairs of departments (two experimental and two control) were chosen in which to conduct the interventions. The first intervention comprised a replication (with enhancements) of Zohar's (2003) safety climate improvement intervention. The results indicated that low trust towards the management and the researcher, the face validity of the intervention, negative past experiences, insufficiently transparent communication and alienation engendered a high resistance to change. Seeking to address the shortcomings of the first, the second intervention represented a more organic approach, in which the improvement programme was designed to mesh with and complement established quality management systems. An improvement in employee safety performance was observed in the first month following its introduction, however, it is also possible that this was a consequence of a lean manufacturing intervention that took place at the same time.

Variables affecting the intervention success were further explored though interviews with a sample of safety experts. This resulted in the development of a six stage model for successful safety culture intervention design and implementation.

The insights gained from these studies were fed back to the industrial sponsor to contribute to corporate insight and understanding into variables impacting on employee safety culture and the design of successful safety improvement programs.

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Chapter 1

Introduction of the Sponsor Company

1.1. Emergence of the study

This Ph.D. project has been developed by the University of Bath and funded by the SW RDA and also an industrial sponsor (manufacturing sector). The full research proposal may be found in Appendix A.

1.2. Introduction of the Sponsor Company

The sponsor company manufactures complex investment-cast turbine airfoils, complex ceramic cores and vacuum alloys. The early history of the company dates back to 1903, when it was established as a mining company in British Columbia, where it extracted copper. In 1958 the company merged with two others focused on metal processing and investment casting of dental, medical, industrial and aircraft parts. In the late 1950s and early 1960s the company acquired several aluminium fabricating companies. By the late 1960s one division of the company specialised in producing medical equipment and another in aluminium activities. In 1966 the company formed an alliance with a machining company from South Western England and in 1971 installed a moulding press and a kiln. In 1975 the site in South Western England built an alloy plant, manufacturing vacuum and air melted alloy. In 1976 the aluminium division formed a corporation. The company grew in response to increasing demands for its products. In 2000 it was acquired by a world leading aluminium manufacturer corporation and to date remains its division in the South West UK.

The plant in South Western England consists of three sites: casting, alloy and core. The three sites produce different goods. The core site manufactures ceramic cores (Fig. 1) that are a necessary element in the production of airfoil turbines.

Figure 1. Ceramic core being machined and finished by hand.

The alloy site produces aluminium bars (Fig. 2) that are used by other business as a raw material in the production of aluminium-based goods.

Figure 2. Production process and the final outcome of alloy manufacturing.

The casting site (Fig. 3) produces complex investment-cast turbine airfoils.

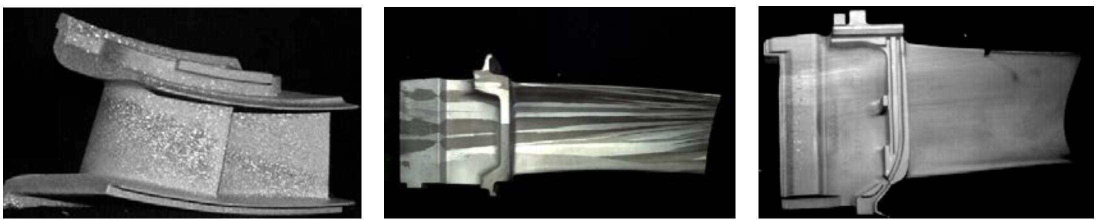


Figure 3. Types of casting products. From left: equiax (many randomly orientated grains), directionally solidified (all grains aligned) and single crystal (one grain).

The three operational units are complementary, as the production process uses ceramic cores and alloy bars for its casting operations. The casting process is multi-staged and very advanced (Fig. 4). It includes manual work, heavy machinery, robots, furnaces and many other elements.

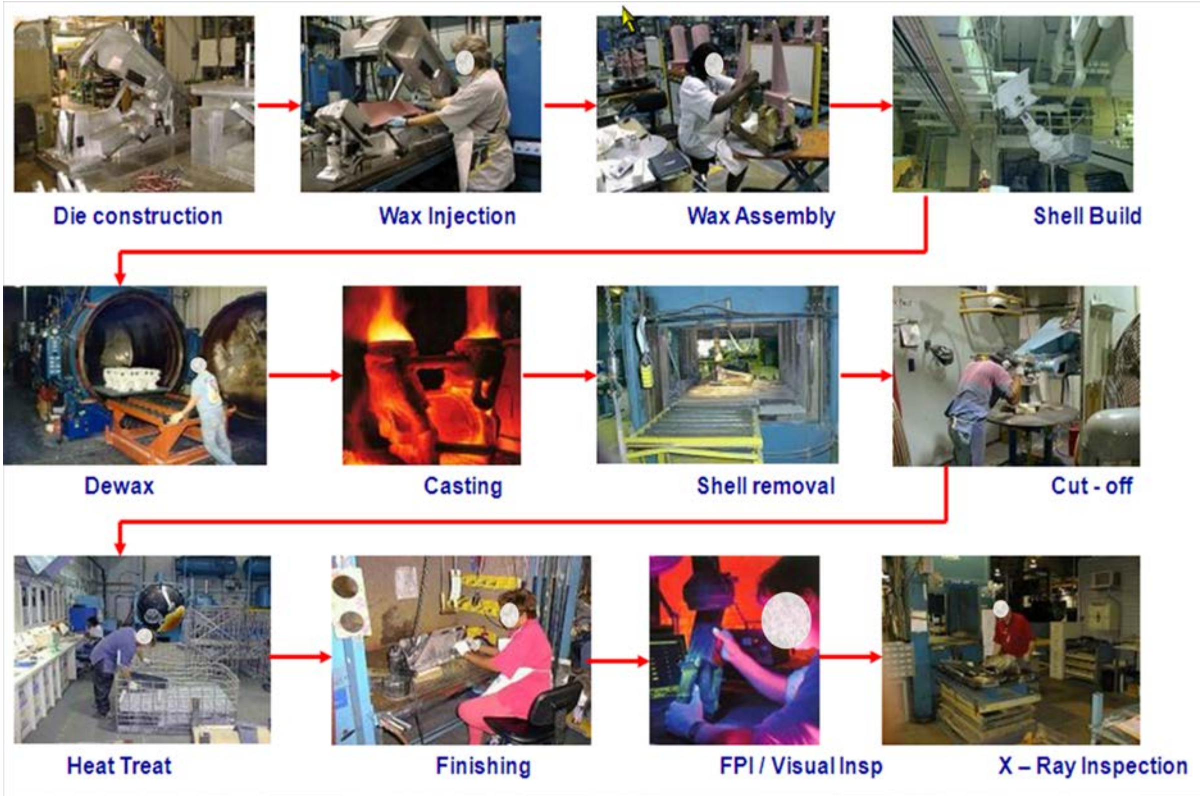


Figure 4. The multi-staged process of manufacturing turbine airfoils.

The final products find use in industrial gas turbines (75%) and jet engines (25%)[1].

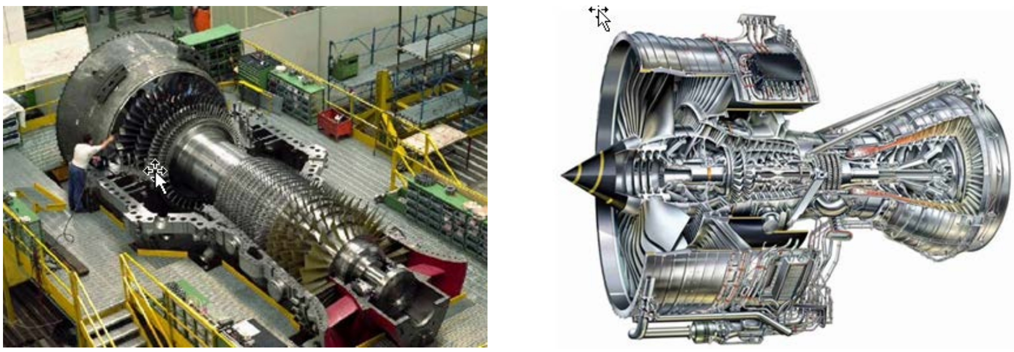


Figure 5. Industrial gas turbine (left) and jet engine (right).

The corporation, the current parent company, is of American origin. It manages 25 business units and alloy-based manufacturing in 450 locations in 36 countries. It employed approximately 107 000 employees worldwide in 2007, 87 000 in 2008 and 59 000 in 2009. The corporate sales revenue was 29 billion dollars in

[1] Data for 2010.

2007, 27 billion in 2008 and 18.7 billion dollars in 2009[2]. The economic downturn experienced in 2008-2010 affected the company's profit and forced it to cut costs, which was reflected in a reduction of the workforce. These changes also affected the site. It employed approximately 1000 people in 2007 and this number was reduced to approximately 700 in 2010.

The sponsor company is a major employer in South Western England, employing mainly local people. Blue-collar workers join the company first through an employment agency as temporary workers and are subsequently given a permanent employment contract if the company is happy with their performance. White-collar workers are employed through a process of selection organised by the company's HR department.

1.3. Hierarchical structure of the company

The production-related departments can be characterised as consisting of four functional layers of personnel: (i) production operators. Their work is physically demanding; they work collectively in groups or shifts each assigned to discrete work cells (small units focused on a single stage of the production process). (ii) Each working group is supervised by a team, shift or cell leaders. These leaders tend to play an active role in the production process, routinely working collaboratively, side by side, with the production operators in their team. Additionally, the leaders are responsible for coordinating employees within their group, shift or cell. Team leaders are, in turn, line-managed by (iii) supervisors. Supervisor responsibilities include job planning, resource assignments, solving problems, and managing personnel within their department. As the first layer of line management, supervisors report to (iv) managers. Managers' responsibility is to manage the department on a strategic level, manage financial resources or coordinate cooperation between departments. The production staff are supported by overhead staff working for HR, finance, engineering etc. For the purposes of this study all these functions were grouped as "Office positions". Additionally as it is an international company, there are a number of people working on site temporarily or engaged in other functions not essential for the production process, or that could not be included to any of the groups listed above, they were categorised as "others".

[2] The employment and sales revenue figures were obtained from the official corporate website.

1.4. Safety performance

One of the core values of the corporation is to continually improve safety, so every year new safety interventions are initiated (see Chapter 4).

With regard to accidents, the number of “all injuries” and “reportable accidents (RIDDOR)”[3] has been declining since 2007 (Fig. 6).

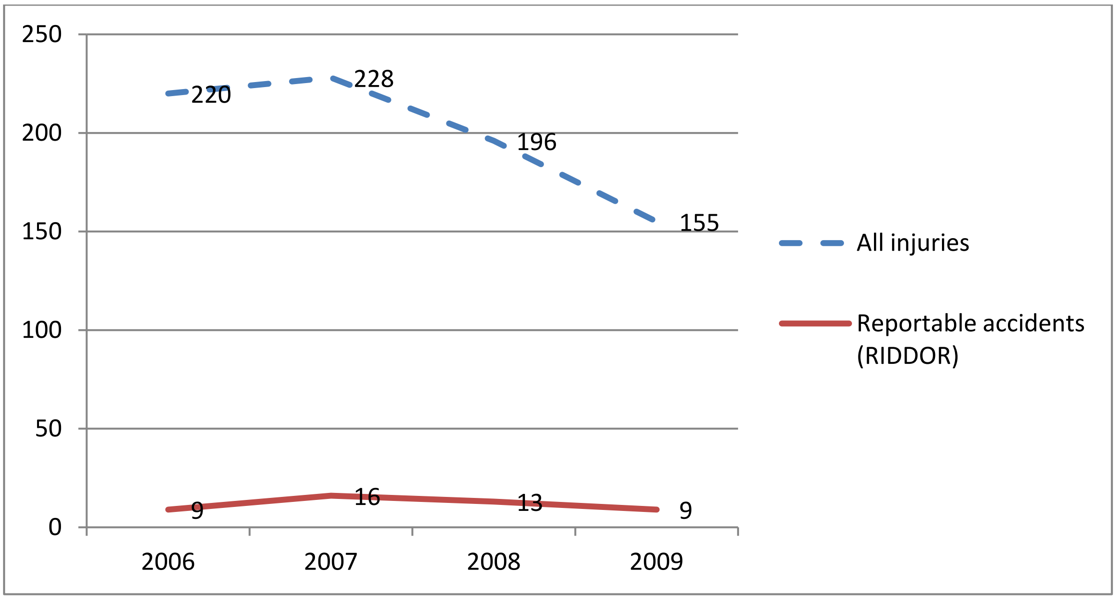


Figure 6. Number of “all injuries” and “reportable accidents (RIDDOR)” in the last four years.

1.5. Thesis structure

The structure of this thesis is discussed in the following paragraphs.

Chapter 2 offers a literature review of contemporary research findings on organisational culture and safety culture.

Aims:

- To develop an understanding of organisational culture and safety culture,
- To develop knowledge of safety culture interventions and insight on why they do or do not work,
- To build up a background for developing and implementing safety culture intervention in the sponsor company,

[3] The Health and Safety Executive in the UK requires employers, as a part of RIDDOR (the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995), to report to the HSE death and major injuries, over-three-day injuries, disease, dangerous occurrences and gas incidents. For a full list of requirements see HSE guidance: http://www.hse.gov.uk/riddor/guidance.htm. Retrieved on 22.08.2010.

- To identify areas for future research.

Methods:

- Available scientific databases were searched for relevant articles, chapters and books,
- The information found was grouped in to topics and the content was synthesised,
- The review of safety culture factors was based on the analysis of available meta-analyses of the subject literature.

Findings:

- There is no agreement regarding the definition of safety culture,
- There may by many cultures within one organisation,
- Management engagement is the most important factor affecting safety culture,
- There are many ways to improve culture,
- Further research is needed better to understand why some improvement interventions are successful while others are not.

Chapter 3 offers a discussion over a methodological approach underpinning research in this thesis.

Aims:

- To set research objectives,
- To develop most relevant research design for given research objectives and practical context on the basis of the understanding of epistemological paradigms,
- To outline the main stages of the research

Methods:

- The relevant literature was reviewed,
- The descriptions of the best practice were reviewed

Findings:

- The uniqueness of this project was discussed
- Four research objectives were set focused on developing an understanding of what works and why and on reducing employee risk taking behaviour,

- The pragmatic paradigm and triangulation methodology were identified as most relevant for the given context,
- Five main stages of research were identified with a detailed list of tasks for each stage.

Chapter 4 discusses the process by which the researcher familiarised himself with the company.

Aims:

- To improve an understanding of the production processes and technical systems in the factory,
- To appreciate the scope of workers duties in particular departments
- To appreciate employees perspectives on safety culture(s)
- To appreciate the risks associated with the socio-technical systems at the plant.

Methods:

- An unstructured interview methodology was used to explore these issues.

Findings:

- The interviews elicited themes that needed to be investigated in a subsequent, more structured stage of research (Gillham, 2005).

Chapter 5 offers a description of the qualitative assessment of safety culture in the sponsor company.

Aims:

- To broaden the insights gained by the preliminary studies
- To gather the material that would be used as a base for the development of a questionnaire to assess the safety culture of the whole company and explore the distribution of safety culture components across departments.

Methods:

- Focus group discussions as suggested by a number of research studies (Cox & Cheyne, 2000; Gillen, Kools, McCall, Sum, & Moulden, 2004; Weyman, Pidgeon, Jeffcott, & Walls, 2006).

Findings:

- Eight facets of safety culture of the sponsor company were identified,

- The strongly contextualised data obtained created a basis for the development of a safety culture questionnaire.

Chapter 6 describes the process of the development of a safety culture questionnaire.

Aims:

- To provide a degree of triangulation of the results obtained in the previous study,
- To identify the finite number of constructs that could be considered as elements composing the company's safety culture and that could be compared with the themes developed from the focus group discussions,
- To explore the distribution of themes across departments,
- To inform the development of safety enhancement intervention.

Methods:

- Principal component analysis
- Group comparison methods (t-test, one-way ANOVA, two-way ANOVA)

Findings:

- Principal component analysis of data from 2008 yielded four components,
- The identified components related closely to those identified in qualitative studies,
- There were differences between job functions and departments confirming the notion of sub-cultures.

Chapter 7 reports two separate studies. The first describes the development and implementation of a safety culture intervention. The second one investigates the reasons behind the failure of the intervention.

Aims – Study 1:

- To develop a model and a process of implementation of a safety intervention developed based on the insight foundation built in the foregoing research studies.

Methods – Study 1:

- Review of relevant literature,
- Quasi-experimental design,

- 360-degree feedback

Findings – Study 1:

- The model and a process of implementation were derived.
- Despite best effort put into the development and implementation, the program participants refused to take part in the study shortly after its commencement.

Aims – Study 2:

- To investigate the reasons behind the failure of the intervention.

Methods – Study 2:

- Individual interviews with intervention participants and external experts.

Findings – Study 2:

- Interviews with the intervention participants helped to identify seven factors affecting motivations to participate in the study,
- Interviews with external experts helped to identify a detailed process with a strong focus on the practicalities of the improvement programs implementation.

Chapter 8 introduces a second intervention, implemented in a different department of the company.

Aims:

- To address the limitations of the previous study,
- To develop a new model and a process of implementation of safety culture intervention.

Methods:

- Quasi-experimental design,
- Standardised Work for Leaders (already existing in the company management system).

Findings:

- A statistically significant improvement in the experimental group was observed,
- The potential causes of this improvement are discussed in depth.

Chapter 9 offers a summary discussion of the results obtained in this research.

Aims:

- To discuss the results of the investigation of the company's safety culture,
- To discuss the lessons learned from the implementation processes of two safety interventions,
- To summarise the findings from chapters Three, Four, Five, Six and Seven,
- To discuss how the findings of this study benefit current academic knowledge,
- To make recommendations for business,
- To suggest areas of future research.

Chapter 2

Literature Review

2.1. Introduction

The costs of accidents and injuries reach billions of dollars and pounds in mature economies. Industrial accidents represent a cost to individuals, their organisations and society. The cost to the United States' economy has been estimated to be $120.7 billion a year (National Safety Council, 1996). The cost to the British economy might have reached as much as £77 billion in 2004 (HSE, 2004). These costs may be even higher for countries with emerging economies. The cost for employers alone might have been between four and eight billion pounds in 2004. More recent research estimated the cost for employers in 2005/2006 between £2.9 and 3.2 billion after exclusion of damage caused by workplace injuries and non-injury accidents (Pathak, 2008). It is not surprising then that a multitude of companies offer a variety of tools and approaches to improve safety and decrease the rate of accidents. A database search of companies in the UK (yell.com) provided 2533 companies associated with Health and Safety consultancy in the UK alone. However, the extent to which these companies' solutions are evidence-based is questionable. If that is the case, the market is full of solutions of questionable effectiveness and companies without appropriate expertise choose the programs based on the selling points rather than hard evidence.

One of the aims of this thesis is to add to the evidence base with regard to which safety interventions work and why. In order to achieve this, a sound theoretical background must be developed. The literature review will inform the development of safety culture interventions for implementation in the sponsor company. Additionally, it will help to develop the researcher's notion of the field of culture, safety culture and interventions and also help to develop research hypotheses and identify a number of areas needing further research.

2.2. Organisational culture

2.2.1. Definitions of organisational culture

It is worth beginning by defining organisational culture with a broader definition of culture itself. The Dictionary.com (2010) defines *culture* as: "*The totality of socially transmitted behaviour patterns, arts, beliefs, institutions, and all other products of human work and thought*".

The Cambridge Dictionary of Psychology (Matsumoto, 2009, p. 146) defines it as: *"a network of loosely interconnected knowledge items produced, reproduced, and updated by a collection of interdependent individuals. An item in the network may refer to a certain declarative knowledge (know what: e.g., beliefs about the social norms) or a certain procedural knowledge (know how: e.g., thinking styles)."*

The definition of organisational culture directly refers to the general definitions mentioned above and worded by Schein (1996, p. 236), who describes "*the set of shared, taken-for-granted implicit assumptions that a group holds and that determines how it perceives, thinks about, and reacts to its various environments*".

In modern organisational studies organisational culture seems to be a pass-key to the majority of areas of organisational performance. It influences leadership (Baumgartner, 2009), information systems (Martinsons, Davison, & Martinsons, 2009), the social responsibility of corporations (Ubius & Alas, 2009), human resource management (Grueso & Anton, 2008), organisational trust (Lawal, 2008) and management satisfaction (Lawal, 2008) to mention just the latest research. However, Brigges (1992), Choudhry et al. (2007) hold that the concept of culture has been over-simplified in many organisational studies, mainly due to a notable diversity in the ways in which culture has been conceptualised and the range of culture paradigms used in organisational studies (Wiegmann, Zhang, von Thaden, Sharma, & Gibbons, 2004)

2.2.2. Difference between organisational culture and organisational climate

The history of organisational studies has developed two research paradigms - organisational culture and organisational climate - that focus on organisational settings and psychological variables. However, as these two research traditions refer to very similar sets of variables, there is an ongoing discussion (Alvesson, 1985;

Meyerson, 1991) over the questions of whether they examine the same phenomenon and which approach is the most adequate for the investigation of organisational settings. Proper distinction between these two traditions is very important from the point of view of a researcher as, on the one hand, the two traditions carry different epistemological assumptions and, as a consequence, preferences towards measurement methods and means of data analysis.

Historically, the theoretical foundations of cultural studies were grounded in the symbolic interaction (Mead, 1934) and social construction perspectives (Berger & Luckman, 1966), whereas the climate literature has its roots in Kurt Lewin's (1951) Field Theory. According to Lewin (1951) behaviour (B) is a function (f) of a person (P) and environment (E): B=f(P,E). In his theory, to study organisational climate, a person must be analytically separated from the social context. Within this approach the "agents" of an organisational system, such as managers, are assumed but not studied directly. The "subjects" of that system, the employees or subordinates that are usually objects of study, work within the climate but do not create it. The effect of the system on individuals is examined, but the process by which this social environment is constructed is neglected. In opposition to the advocates of Lewinian theory are the supporters of the symbolic interaction perspective (Mead, 1934) and social construction perspective (Berger & Luckman, 1966) (foundations for cultural studies) who claim that an individual cannot be analytically separated from his environment and that he/she is an "agent" and a "subject" simultaneously. In this cultural approach, the recursive dynamics between an individual and the system are the primary topics of interest (Hatch, 1993; Rohlen, 1974).

These two different epistemologies influence the research methods used, because if environments exist independently of an individual, as Lewin suggests, then it is more sensible to conceptualise, measure and compare them as social entities. However, if environments are considered inseparable from individuals and as unique social constructions, that creates unique meaning systems for their members (Lave & Wenger, 1990) and comparisons across settings are much more difficult if not impossible. For example, Joyce and Slocum (1984) argued that individuals sharing the same set of social-psychological variables should be regarded as sharing the same "climate". On the other hand, Geertz (1973) suggests that meaning and symbolic representation can be understood only with respect to the specific settings and thus every culture is unique and must be investigated and described at the level that allows an understanding of individual meaning and organisational symbolism. Therefore, studying culture requires qualitative methods and an appreciation of the unique aspects of individual social settings with an emphasis on the underlying assumptions (Kunda, 1992) and individual meaning (Pondy, Frost, Morgan, & Dandridge, 1983). By contrast, studying organisational climate requires quantitative methods to allow the generalisation of perceptions of observable practices and procedures across social settings (Guion, 1973).

However, despite this arguably clear distinction between the terms, there is still a lot of confusion regarding their usage. A large number of articles can be found that apply quantitative research methods to the study of culture (Calori & Sarnin, 1991; Denison & Mishra, 1995; Gordon & Ditomaso, 1992). It seems that, by applying survey methods to study the comparative dimensions of culture, these authors contradicted the epistemological foundations of culture research in organisational studies.

Looking more closely at the subject literature and research undertaken it is not clear whether culture and climate represent two entirely separate phenomena or whether they represent the same phenomenon examined from different perspectives. For example, Schwartz and Davies (1981) developed a set of indicators that can reveal an organisation's culture: decision making, communicating and organising. Interestingly, these dimensions overlap with the organisational climate dimensions developed by Taylor and Bowers (1972): decision making practices, communication flow and the organisation of work. Other examples refer to variables similar to culture or climate, like risk taking (Litwin & Stringer, 1968; Oreilly, Chatman, & Caldwell, 1991) or the concept of autonomy (Joyce & Slocum, 1982; Schein, 1985). There are even more fundamental similarities between the two approaches. Both perspectives attempt to address the problem of social context being simultaneously the product of individual interaction and a powerful influence on individual interaction (Ashforth, 1985; Golden, 1992). Also, both perspectives are considered to be multilayered (Glick, 1985; Schein, 1985). Following an in-depth analysis of the differences and similarities between culture and climate, Denison (1996) concluded that these two research traditions should be viewed as a difference in interpretation of the same phenomenon rather than two different phenomena.

Based on the arguments presented above, climate and culture will be considered in this thesis as two interpretations of the same phenomenon that call for different research methods (qualitative for culture and quantitative for climate) to address differences in these interpretations. The terms “culture” and “climate” will be used interchangeably in this thesis. Further discussion regarding the relevance of these terms in safety science will be presented in the following sections of this chapter.

2.2.3. Paradigms of organisational culture

After many years of research there is still no consensus with regard to what exactly organisational culture is, or how to research it. There are many approaches that can be taken to understand this phenomenon, and many of them offer contradictory results.

Three main paradigms can be distinguished. In the integration perspective, culture is a shared understanding. This approach seems to be the most popular one in the literature. Its supporters (e.g. Schein, 1985) hold that organisational culture has many manifestations, such as espoused values, formal practices, informal practices, stories about employees, rituals and jargon. Cultural manifestations are consistent and work as an integrative mechanism. One common culture in this approach is a sign of an organisation’s strength and diversity is treated as a signal of weakness. For example, O’Reilly et al. (1991) found that when there was higher similarity between values approved by managers and their subordinates, the job satisfaction of subordinates was higher and intention to leave was lower. This research advocates the main assumption of the integration approach, namely, that culture brings positive effects if it is unitised and strong. This approach also assumes that culture may be modified and used by management to influence the workforce (Schein, 1985).

However, despite the popularity of this approach, it is not devoid of weaknesses: most studies focus on only one or two types of cultural manifestations such as values (Helfrich, Li, Mohr, Meterko, & Sales, 2007) instead of all of them. The consequent issue is that integration studies sometimes generalise from a single type of manifestation to the culture as a whole (Martin, 1992). There is also a measurement problem that refers to the attempts made to establish a causal relationship between organisational culture and organisational effectiveness (Yilmaz & Ergun, 2008). In reality, a company’s performance is affected by many non-cultural variables like economic conditions, product mix or competitors that should be controlled in such a study. Until then, any connection between culture and performance must be deemed unproven. Another methodological critique was made by Alvesson (2002), who reviewed organisational culture studies to discover that most of these studies relied primarily on data from managerial and professional employees gathered by researchers who were employed by business schools and who, therefore presented the managerial point of view.

The competitive approach to the integration perspective is a trend known as differentiation perspective, which contradicts assumptions about unitary culture and emphasises that cultural manifestations are inconsistent and that consensus may be achieved only within sub-cultural boundaries (Young, 1989). Culture is seen as a product of social structures, determined by factors like division, department, workgroup (Choudhry, et al., 2007), profession, gender, class, ethnic group, nation (Richter & Koch, 2004) and hierarchy (Kreitner & Kinicki, 2001). Cultures can coexist and some of them can be dominate over others (Richter & Koch, 2004). An example of this approach is provided by a study conducted by Bartunek & Moch (1991). They showed that five subcultures in a food production firm reacted differently to management's imposition of a Quality of Working Life Intervention.

An alternative approach called "ambiguity" or "fragmentation" states that interpretations of cultural manifestations are multiple – neither clearly consistent nor clearly inconsistent. Differences in meanings, values and norms are incommensurable and irreconcilable. The consensus is not organisation-wide nor is it specific to a given sub-culture. In addition, during the continual process of developing meanings, members can orientate themselves differently at different times and stages (Richter & Koch, 2004). An example of the fragmentation approach is demonstrated by Robertson and Swan (2003) who studied highly educated consultants working in a knowledge-intensive firm where project work was fluid, complex and uncertain, making the acceptance of ambiguities unavoidable. The study demonstrated that in cultural research, the personal and subjective interpretation of ambiguities must be taken into consideration. This approach is in clear opposition to the two aforementioned perspectives and this contradiction is expressed by, for instance, Schein (1985), who dismisses the idea that ambiguity is a part of culture. Nevertheless, fragmentation research warns against the assumption that culture is defined by strongly shared values, interpretations and predictable behaviours (Martin, Frost, & O'Neill, 2006).

It seems that these perspectives exist in conflict; however, none can be rejected, as all of them are supported by evidence, so it is not surprising that a meta-theory has been developed in an attempt to combine all of these approaches. Martin (2002), based on empirical evidence, demonstrated that all three perspectives may be found in any in-depth study focused on organisational culture and he assumes that when organisational culture is seen from these three perspectives a more complex understanding will emerge. This multiple configuration holds that different cultures can not only exist within the workplace, but can also overlap and interact (Richter & Koch, 2004). However, even though it is called a meta-theory, its weakness is that it is based on only the three major perspectives and ignores unclassifiable research (Martin, 1992).

2.2.4. Layers and functions of organisational culture

The existence of layers and functions of organisational culture was hypothesised by thinkers and practitioners like Keesing (1974) or Schein (1981, 1984, 1985). Their ideas are based on theoretical insights and observations and no empirical evidence has been provided to support their statements. Nevertheless, their approach has been widely accepted by academics and practitioners and these authors are quoted in most text books about organisational psychology. Although there is no empirical confirmation of their ideas it is valuable to refer to these authors and their followers to analyse closely their arguments on the development of organisational culture research.

According to Schein (1985), layers of organisational culture have different levels of accessibility. In the summary made by Glendon & Stanton (2000), layers were divided into three levels. The most accessible are (patterns of) behaviour, artefacts, language and stories. At the intermediate levels of accessibility are beliefs, values and behavioural norms that can be inferred from observed phenomena. The deepest level contains mental constructs that are named differently by different authors: underlying assumptions (Schein, 2004), fundamental assumptions, core values (Rousseau, 1990) and ideologies (Deal & Kennedy, 1986). They are often unconscious and may not be articulated (Glendon & Stanton, 2000).

The functions of organisational culture were first described by Siehl and Martin (1984) and were later extended by Steven (1989) and Kreitner & Kinicki (2001). According to the aforementioned authors, organisational culture fulfils the following functions:

1. It gives members an organisational identity and defines and maintains boundaries, allowing the identification of members and non-members.

2. It facilitates collective commitment. It provides shared patterns of affect, an emotional sense of involvement and commitment to organisational values and moral codes so that organisation members know what they are expected to value and how to feel.
3. It promotes social stability. It provides patterns of cognitive interpretations or perceptions, so that organisation members know how they are expected to act and think.
4. It shapes behaviour by helping members make sense of their surroundings. It functions as an organisational control system, prescribing and prohibiting certain behaviours.

2.2.5. Effect on behaviour

One of the functions of organisational culture is said to be the shaping of behaviour (Kreitner & Kinicki, 2001). According to Argyris (1970) culture affects the type and quality of interpersonal relationships, which in turn affect people's effectiveness. Certain shared cultural meanings define what are acceptable, natural, desirable ways of relating and acting in a given organisational context. Bate's (1984) research findings suggest that certain cultural orientations have an important psychological impact, producing a sense of futility and pessimism in people. An organisational culture can transmit to its members, *a priori*, the assumption that they are powerless – without their actually having to experience this at all. As a result helplessness becomes an internalised norm that is never tested and the resulting lack of change reinforces the initial cultural assumption. The culture is confirmed and the circuit between no action and no motivation is closed.

Amsa (1986) demonstrated a strong relationship between organisational culture and "loitering" behaviours in a group of loom shed workers. The results of Marcoulides and Heck (1993) demonstrate that organisational culture affects organisational performance and productivity which is a direct consequence of behaviour. Carmeli (2005) demonstrated that an organisational culture that provides challenging jobs diminishes employees' absenteeism and withdrawal intentions from the occupation job and the organisation. This relationship between dysfunctional culture and dysfunctional behaviour was confirmed by Balthazard, Cooke, & Potter (2006). Their results clearly demonstrate the positive effect of constructive cultural styles, and the negative effect of dysfunctional defensive styles on operating efficiency and effectiveness.

An indirect criticism of the relationship described above between organisational culture and behaviour is introduced by the systems theory, especially the open system framework represented by Katz and Kahn (1978), which would categorise the above research as reductionist, arguing that behaviour in organisations should be considered as one of the elements of the system. Systems thinking is a framework that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation. The only way fully to understand why a problem or element occurs and persists is to understand the part in relation to the whole (Capra, 1996). Burke and Litwin (1992), based on their extensive experience in delivering organisational change in large organisations, developed a model of organisational performance and change that uses an open system framework to operationalise the factors that may affect behaviour. The factors they propose to consider when investigating elements influencing behaviour are:

- External environment;
- Mission and strategy;
- Leadership;
- Organisational culture;
- Structure;
- Management practices;
- Systems (policies and procedures);
- Work unit climate;
- Task and individual skills;
- Motivation;
- Individual needs and values;
- Individual and organisational performance (behaviour).

According to their model, every element from the list above influences all other elements. Therefore, to understand behaviour, the influence of all these factors should be considered and analysed not just culture.

2.2.6. Summary

The foregoing section provided a brief overview of our contemporary understanding of organisational culture and climate and provides the historical and conceptual backdrop to a safety culture paradigm. It draws heavily on the framework developed by Guldenmund (2000), who analysed an extensive number of literature studies about organisational culture and suggested six features of organisational culture:

1. It is an abstract construct rather than a concrete phenomenon.
2. It is relatively stable.
3. It is something shared by groups of people.
4. It consists of various aspects – different types of cultures can be distinguished within one company like: service culture, innovative culture, safety culture.
5. It constitutes layers.
6. It is functional – supplies a frame of reference for behaviour.

The following section will introduce the concept of safety culture. Safety culture is considered a part of organisational culture and shares its properties. Therefore, safety culture should be discussed in the light of the above findings.

2.3. Safety culture

2.3.1. Background and history

The development of the safety culture concept is an effect of the evolution of safety management systems and understanding accident causation. The theories of accident causation have progressed through several stages in an effort to identify the root causes of system failures. The first stage, which spanned the period 1940-1960, was focused on machines and hardware improvements because, due to the rapid development of new machinery, most accidents were attributed to mechanical malfunctions (Cooter & Luckin, 1997). The second stage, which took place between 1960 and 1980, focused researchers' attention on human factors, because employees were seen as the weakest link in the system (Gordon, Flin, Mearns, & Fleming, 1996). The third stage considered the interaction of human and technical factors (Cooter & Luckin, 1997). The most recent stage considers organisational culture an influential factor (HSE, 2005a; Wiegmann, Zhang, von Thaden, Sharma, & Mitchell, 2002a, 2002b). Zohar (1980), based on the work of Schneider (1975) on organisational climate, developed the concept of safety climate defined as "*a summary of molar perceptions that employees share about their work environments…which acts as a frame of reference for guiding appropriate and adaptive task behaviours*".

At around the same time as the disastrous nuclear accident at Three Mile Island (U.S.A.) in 1979 and Chernobyl (Ukraine) in 1986, public attention became focused on nuclear safety issues. The accident investigation in Chernobyl revealed many irregularities in organisational safety. The International Nuclear Safety Group's (INSAG) Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident, published by the IAEA as Safety Series No. 75-INSAG-1 in 1986, used the term "safety culture" for the very first time to describe a set of factors related to the organisational facets of safety (Choudhry, et al., 2007). INSAG's publication made no reference to any academic literature. This case suggests that the term "safety culture" was not developed on the basis of organisational culture studies or other research in any other field (Choudhry, et al., 2007). The meaning of the term and its usage were undefined and left open to discussion and interpretation. The term "safety culture" was subsequently cited in major accident investigation reports, such as that of the Zeebrugge ferry sinking, the King's Cross Underground fire, the Clapham Junction disaster, Piper Alpha (Clarke, 2000) and the structural break up and crash of

Continental Express Flight 2574 in Texas on September 11, 1991 (Wiegmann, et al., 2004).

As demonstrated above, historically, the two concepts of "safety culture" and "safety climate" were developed separately: "safety climate" had its genesis in the subject research literature and "safety culture" has been used arbitrarily by accident investigators with no reference to any scientific source of information (Choudhry, et al., 2007).

It seems that the meanings of these two concepts were not distinguished explicitly and as a result they have been used interchangeably. However, it is worth mentioning that the origin of the term "safety climate" is related to organisational culture research heritage. Despite the vague heritage of the term "safety culture" and its confusion with "safety climate," many authors attempted to distinguish these two terms. The next paragraph will introduce the differences.

2.3.2. Safety culture and safety climate: distinction and definitions

As these two terms – "safety culture" and "safety climate" – are being used to describe a similar phenomenon, they can be a source of confusion. The meanings of the two terms evolved alongside the development of safety management systems. The subject literature attempted on a number of occasions to establish a final definition of both terms and make an explicit distinction between their meanings.

Wiegmann *et al.* (2002; Wiegmann, Zhang, et al., 2002a) analysed 18 articles that provide "safety culture" definitions and 12 articles that provide definitions of "safety climate". They suggested a hybrid definition for the two terms:

"*Safety culture is the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organisation. It refers to the extent to which individuals and groups will commit to personal responsibility for safety, act to preserve, enhance and communicate safety concerns, strive to actively learn, adapt and modify (both individual and organisational) behaviour based on lessons learned from mistakes, and be rewarded in a manner consistent with these values*"(p.8).

"*Safety climate is the temporal state measure of safety culture, subject to commonalities among individual perceptions of the organisation. It is therefore situationally based, refers to the perceived state of safety at a particular place at a* *particular time, is relatively unstable, and subject to change depending on the features of the current environment or prevailing conditions*"(p.10).

Despite this analytical approach and summarised definitions, there is no common agreement on these definitions and the terms are still being used interchangeably in the literature (Jeffcott, Pidgeon, Weyman, & Walls, 2006). Therefore in the present work these terms will be used interchangeably as well. It is dictated by the arguments discussed in the previous section that climate and culture are facets of the same phenomenon.

2.3.3. Components of safety culture

Components of safety culture can be discovered using quantitative or qualitative methodologies. The quantitative approaches tend to use statistical tools such as Factor Analysis (FA), Principal Component Analysis (PCA) or Homogeneity Analysis (HOMALS) (Guldenmund, 2000) in order to identify the underlying structure (Wiegmann, et al., 2004) of the respondents' tendencies to evaluate certain questions in questionnaires in a similar way (Guldenmund, 2000). The development of the dimensions and the final results depend on many methodological facets like question wording, style and number of items (Flin, Mearns, O'Connor, & Bryden, 2000), different analysis tools like FA or PCA (Guldenmund, 2000), sample (size, composition), industry (Clarke, 2000), country of origin (Clarke, 2000) and the labelling of factors (authors have freedom in labelling factors and do not have to relate it to previous studies (Guldenmund 2000)). Idiosyncratic item writing (Flin, et al., 2000) and language used (Flin *et al.,* 2000) can also be problematic.

The aforementioned issues are responsible for a large number of dimensions reported in the literature. These factors also cause considerable disparity in the number of factors in different studies, which vary from 2 to 19 (Guldenmund, 2000; Flin *et al.,* 2000) and are probably the reason for which different studies fail to confirm factor structures of previous studies (Guldenmund, 2000; Flin *et al.* 2000; Clarke, 2000).

The meta-analysis of study results can be a solution to this problem. The aim of meta-research is to gather commonalities from a range of detailed investigations. Because names of factors are descriptive and strongly depend on the creativity of authors, a meta-analysis can be conducted only by using qualitative means to investigate its content.

There are two types of meta-studies available to identify the common components of safety culture. In the first type, authors compare studies that used variations of the factor analysis tool in order to explore or confirm the factorial structure of their data sets. In the second type, authors try to identify organisational indicators of safety culture based on a review of specific and detailed findings. There have been many recent reviews of the literature in this area. The spine of the literature review here is based on available review articles (N=6, which reviewed 62 papers all together – see Appendix B): three of them focused on comparisons of factorial models and another three sought to identify indicators of safety culture by reviewing other research papers and reports. It seems more valuable to review these reviews, especially in consideration of the fact that particular reviews cover only a fraction of the available materials and looking at a number of review studies may provide a more general insight into safety culture commonalities among a large number of scientific papers.

A review conducted by Seo, Torabi, Blair, & Ellis (2004) suggests that there are five main indicators of safety culture. Clarke (2000) analysed 16 studies that performed factor analysis and extracted the dominant themes common across the studies. It is worth mentioning that such meta-analysis is not a statistical one, but is based on analysis of labels and written descriptions of factors. She ended up with five main categories. A similar analysis was conducted by Flin et al. (2000). The authors analysed 18 studies and identified the five most common themes. Farrington-Darby (2005), after reviewing 15 studies, identified common factors. A literature review of 10 studies conducted by Wiegmann et al. (2004) identified five indicators of safety culture and the report prepared for the Health and Safety Executive (HSE, 2005b) identified five core dimensions. The table showing what papers were reviewed by each article may be found in Appendix B. Table 1 provides the names of the factors identified for every review paper.

Table 1. *Comparison of safety culture dimensions identified in meta-analysis studies*

Dimensions identified in the meta - analysis of studies that used factor analysis			**Dimensions identified in the literature reviews**		
(Seo, et al., 2004)	(Clarke, 2000)	(Flin, et al., 2000)	(Farrington-Darby, Pickup, & Wilson, 2005)	(Wiegmann, et al., 2004)	(HSE, 2005b)
Co-worker safety support	Work task/work environment	Work pressure	Reporting system	Reporting systems	Two-way communication
Management commitment to safety	Management attitudes	Management/supervision	Management commitment	Management involvement	Leadership
supervisor safety support	Management actions	Risk	Immediate supervisors and supervisor-subordinate relationships	Reward Systems	Involvement of staff
competence level of employees with regard to safety	Individual responsibility and involvement	Competence	Individual and behavioural factors (involvement, competency, training, attitude, behaviour	Employee Empowerment	Existence of learning culture
employee participation in safety-related decision making and activities	Safety management system	Safety system	Rules and procedures	Organisational commitment	Existence of just culture
			Communication		

This summary shows that the common factor identified in all reviews, and therefore in all reviewed papers, was leadership (blue) and its different aspects (management attitudes and actions, commitment, involvement, supervisory support and relationship). The second most common factor was employee involvement/empowerment (red). Four out of six review studies identified it as common to most of the research papers they reviewed. There are a number of safety culture indicators identified by only two out of six reviews. These are: safety management system (green), competence (yellow), communication (violet), and reporting systems (orange). Nine out of 31 (29%) indicators identified by all reviews were unique. This suggest that despite very intense research effort focused on discovering what safety culture really is and what it is composed of, there still remains disagreement with regard to most indicators. The only factor identified by all studies is the importance of management being involved in H&S issues. The explanation of the ways in which management may support safety and the mechanism underlying their effect on companies' safety culture will be described in the next section.

2.3.4. Safety culture and leadership

The analysis of the common safety culture indicators, discussed in the previous section, revealed that only the leadership involvement was common to all reviewed studies. In order further to investigate the relationship between safety culture and leadership it seems justified to introduce the concept of leadership styles and their effect on safety culture, to analyse the effect of different functional positions (supervisors and managers) within a company on safety culture, and to analyse what specific managerial and supervisory behaviours affect safety culture.

In recent years different dimensions of leadership research have been merged into two basic styles (HSE, 2005b; Judge & Piccolo, 2004): "transformational leadership" and "transactional leadership". Transactional leadership refers to the nature of the relationship between a leader and his or her subordinates. A good transactional leader can reconcile his or her self-interest with that of the employees. The transactional leadership (Whittington, Coker, Goodwin, Ickes, & Murray, 2009) style has two main sub-dimensions: active (also called constructive) and passive (also called corrective or management by exception). Zohar (2002) added a third dimension: laissez-faire style, but Krause (2005) opines that this style is not a dimension of the transactional-active style, but refers to an abdication of leadership responsibility. Hence it is an effect of lack of leadership rather than a dimension of a particular leadership style.

In the transactional-active style (Bass, 1990; Yukl, 1998) a leader clearly communicates his or her expectations to his or her employees and then monitors and reinforces good performance. He or she is concerned with members' welfare and seeks to identify their needs, desires and capabilities in order to offer motivationally relevant rewards. Such an approach results in a reduction of power distance and results in closer relationships between the leader and the subordinates. On the other hand, the transactional-passive (Bass & Avolio, 1997) style is deployed by a leader who waits until something goes wrong (detection based on active or passive monitoring) and reacting with the appropriate consequence (correction in relation to required standards). This style expresses a lower level of concern for workers' welfare and results in a poorer, non-individualised interaction between a superior and subordinate (Zohar, 2002b).

The second leadership style - transformational - (also called relationship-oriented, charismatic or inspirational (Krause, 2005)) is characterised by value-based, individualised interaction, resulting in greater concern for employees' welfare (Simola, Barling, & Turner, 2010). This style is focused on the future and the development of relationships between leaders and followers. The role of a leader who deploys the transformational style is to inspire employees to go above and beyond their mere self-interest (Krause, 2005; Zohar & Tenne-Gazit, 2008).

Leadership style is related to safety performance. Zohar (2002a) found a significant positive relationship between transformational leadership and safety climate (defined as supervisory communications with their subordinates about safety issues: $r=.048$, $p<.01$) and transactional-active leadership styles and safety climate ($r=0.34$, $p<0.05$). Moreover, there is a negative relationship between the transactional-passive style and safety climate (defined as prioritising safety over production) ($r=-0.33$, $p<0.05$) and the same dimension of safety climate and laissez-faire leadership styles ($r=0.41$, $p<0.01$) (see Kelloway, Mullen, & Francis, 2006). Zohar's results indicated that the transformational leadership style positively influenced open safety communication, whereas transactional-passive leadership style increased the priority of production over safety. Furthermore, Zohar (2002a) found that the transformational style and transactional-active styles predict injury rate after controlling for risk in investigated departments, and that this relation is mediated by a dimension of safety climate related to communication. The results of multiple regression yielded the following values for the transformational style: TL(β)=-0.38, $p<0.01$; risk(β)=0.07; $R^2=0.14$, $p<0.05$ and the following for the transactional active: TAL(β)=-0.29, $p<0.05$; risk(β)=0.05; $R^2=0.21$, $p<0.05$ These findings were confirmed by Krause (2005) and Barling, Loughlin, & Kelloway (2002). Moreover, research by Kelloway, Mullen, & Francis (2006) not only confirmed the above, but also demonstrated that the transactional-passive leadership style has a detrimental effect on both safety climate and safety consciousness. Authors applied structural equation modelling and indicated that safety-specific transformational leadership predicted safety climate $\beta=.28$, $p<.01$ and safety consciousness $\beta=.25$, $p<.01$ and that these two variables were also negatively predicted by safety-specific safety leadership (safety climate: $\beta=.-25$, $p<.01$ and safety consciousness: $\beta=-.33$, $p<.01$). Their model accounted for 56% of the variance of safety climate and 46% in injuries. These findings were confirmed by Mullen & Kelloway (2009) who found that providing training on transformational leadership to a group of managers in the health-care sector resulted in significant improvement in safety climate perceptions. The authors randomly assigned managers working in the healthcare sector to three training groups. One group was given training on general transformational leadership; the second group was trained in safety-specific transformational leadership and the third group, the control group, did not receive any training. The safety climate and skills of the leader's were assessed before and after training. The results indicated that safety-specific training produced the strongest improvements: $F(2,54)=2,69$, $p<.05$ and that there was a significant effect of training on safety climate ($F(2,10)=3,55$, $p<.05$) (see also Parry & Sinha, 2005). Conchie & Donald (2009) investigated the interdependence between transformational leadership style and safety citizenship behaviour to discover that this relationship is moderated by the level of safety-specific trust ($\gamma=.09$, $p< .05$). The transformational style affected safety behaviour only when there was a high (simple slope=.30; $t=2.28$; $p<.01$) or moderate (simple slope=.22; $t=1.94$; $p<.01$) level of safety-related trust. There was no effect with low levels of safety-specific trust (simple slope=.14; $t=1.03$; *ns*). The reason behind that finding may be the role of trust which affects followers' vulnerability to the leader's suggestions. Yule & Flin (2002) found that two elements of the transformational leadership style (intellectual stimulation and idealised consideration) and one element of the transactional leadership style (contingent reward) were found to be significantly associated with lower accident rates. The evidence for this relationship is strong and is further confirmed by McFadden, Henagan, & Gowen (2009, p. 399), who found that:

"The charismatic-inspirational leadership style is directly related to a culture of safety within the hospital, which is tied to the successful implementation of PSI (patient safety initiatives), and ultimately to improved PSO (patient safety outcomes). These PSO include the reduction in the frequency, severity, and impact of errors, as well as heightened awareness and understanding of errors."

These results suggest that the transformational style of leadership is of great importance, as it leads to improvements in safety performance and reduced injury rates, even in environments in which a low priority is assigned to safety. It is of great significance that training may make a conspicuous difference. This offers some hope that safety may be improved by improving the leadership style of the top management. However, further research is needed to identify what type of training is most effective.

Although every leader in organisational settings will have a specific leadership style, it is argued that different functional positions (directors, managers, supervisors) affect safety differently (Flin & Yule, 2004; Luria, Zohar, & Erev, 2008; Zohar, 2000). Thompson, Hilton, & Wilt (1998) demonstrated that managers' support for safety had different outcomes than supervisors' support for safety: $\chi^2(1)=51.69$, $p<.001$. Namely, managers' support was a mediator between organisational politics and safety conditions, whereas supervisor support for safety was a mediator between supervisor fairness and safety compliance.

It is further argued that this divergence arises from differences in managerial and supervisory duties (Thompson, et al., 1998). Zohar (2005) claims that these differences create two types of safety climate in a company. The first one – organisation level climate - is related to shared perceptions of institutional procedures created and implemented by managers. These perceptions inform employees of the desired role behaviour and suggest priorities for competing goals. The second one – group level climate - is related to workers' perceptions of supervisory practices. The predictive validity of this construct was established by correlating organisational level safety climate safety audit scores ($r=.46$, $p<.01$) and group level safety climate with safety behaviour observations ($r=.38$, $p<.01$).

It seems that the discussion of leadership styles, while informative, is still quite generic and does not clearly express what exactly supervisors and managers must do in order to improve safety climate. To address this limitation, the literature was examined to identify what types of behaviours are important for shaping safety culture in companies.

2.3.5. Safety culture and employee behaviours

Supervisory and managerial behaviours

17 papers were found on the subject of supervisory behaviours and 11 papers examining managerial behaviours. The behaviours listed in these papers were coded by the researcher in order better to understand what classes of behaviour shape safety culture. This allowed the creation of a number of dimensions, or categories, of supervisory and managerial behaviours. The full list of categorised behaviours with

the literature sources can be found in Appendix B. The grey rows in the table below show corresponding areas – similar groups of behaviours in both groups that affect safety climate. The numbers in brackets indicate how many particular behaviours were identified in the literature review as belonging to a particular category. It seems clear from this comparison that there is more insight into the behaviours of supervisors than that of managers.

Table 2. *Numbers of supervisory and managerial behaviours identified in the subject literature*

Supervisors		Managers	
Category	Sub-category	Category	Sub-category
Can be trusted (4)		Can be trusted (1)	
Does not turn a blind eye (7)		Does not turn a blind eye (2)	
Communication	Discusses safety (6)	Communication	Discusses safety (3)
	Praises safety behaviours (8)		Praises safety behaviours (1)
	Welcomes reporting safety issues (8)		Welcomes reporting safety issues (5)
	Explains/educates about safety (5)		Provides safety information (9)
	Provides safety vision (1)		
	Repeatedly emphasises importance of safety (10)		
	Sets consequences for behaviours (2)		
	Provides feedback (3)		
Improves safety knowledge (1)		Considers safety important (8)	
Is fair (5)		Promotes peoples based on safety records (1)	
Cares about personal issues of his group members (3)		Prevents safety problems (2)	
Allocates safety resources (3)			
Monitors / observes / controls behaviours (10)			
Engages employees in safety activities (9)			
Acts based on suggestion (4)			
Leads by example (6)			

There are some areas of safety-related behaviours that are common to both functional groups, such as discussing safety, praising safe behaviour and welcoming the reporting of safety issues. These are the elements of communication that, according to the literature, should be demonstrated by supervisors and managers. Not turning a blind eye and building trust are other shared features of leaders in both functional positions. Here the similarities end. With regard to other components of communication, the role of the manager is to provide strategic safety information like statistics and informing personnel of new policies etc. The role of the supervisor is to provide a more contextualised understanding of safety by educating or explaining, emphasising the importance of safety, providing feedback on performance and reprimanding if necessary. The analysis suggests that, in order to enhance safety culture, supervisors should monitor the behaviour of their team mates while maintaining interest in their personal matters and trying to create a positive atmosphere of cooperation. Moreover, good supervisors engage their operatives in safety activities, welcome the reporting of safety concerns, and act on these suggestions. They also lead by example and do not use double standards.

However, with regard to managerial behaviours, the literature is more vague. The listed behaviours are not very specific. The list of behaviours may be limited due to the fact, that it is difficult to investigate managerial behaviours as this group is not easily accessible. This limitation shows that further research in that field is necessary.

Blue-collar workers behaviours

When trying to analyse the relationship between safety culture and safe behaviour, the problem of the definition of safe behaviour is encountered. Is it reactive (avoiding danger) or proactive (removing hazards)? The problem of definition is crucial and it has profound methodological consequences related to measurement. There is no explicit definition of safe behaviour in the literature. This is because what is safe or unsafe is defined by the context of a particular workplace. The type of work, legal rules, local policies and procedures and managerial expectations define what behaviours are welcomed and which are forbidden.

Another problem concerns the question of whether safety climate is related to safe behaviours directly or whether it is mediated by other factors. Research conducted by Glendon & Litherland (2001) supports a direct relationship between these two variables; however, there are a considerable number of studies demonstrating a non-direct relationship mediated by: production pressure (Hofmann & Stetzer, 1996), leadership (Zohar & Luria, 2003) or knowledge and motivation (Brown, Willis, & Prussia, 2000; Larsson, Pousette, & Torner, 2008; Neal & Griffin, 2002).

Clarke (2006b), in her meta-analytic review of 35 studies, demonstrated that a positive safety climate is significantly correlated with better safety performance, and in particular with safety participation. However, looking more closely at these and newer studies not included in the review, a number of concerns emerge. Firstly, the research studies come from different countries: China (Zhu, Di, Gui, & Clissold, 2010), Australia (Fogarty & Shaw, 2003), USA (Morrow et al., 2010) or Turkey (Omer & Selahattin, 2009), and this limits their generalisability. Further, most of these studies (except Cooper & Philips (2004), who applied observational methods) use self-report questionnaires to establish the rate of unsafe behaviours. This practice raises serious questions regarding the ecological validity of these studies, i.e. to what extent the behaviours reported by employees really took place in their work environments. Another difficulty is the validity and reliability of the measures originally developed in English-speaking countries and subsequently translated.

Also, the definition of unsafe behaviour is not unified. For example, Wills, Watson, & Biggs (2009) discuss unsafe driving behaviour, Garavan & O'Brien (2001) discuss a variety of behaviours including breaking safety rules, communication or housekeeping. This lack of a clear definition of unsafe behaviour partially stems from the fact, that, depending on the industry, different behaviours are considered unsafe; this confuses the understanding of the concept of unsafe behaviour and limits the comparability of these studies.

In addition, different studies use different safety climate measures that focus on a diverse range of dimensions. For instance, safety climate in the study of Morrow, et al. (2010) consisted of three factors: management safety, co-worker safety and work-safety tension, whereas in the study of Omer & Selahattin (2009), safety climate consisted of five factors: PPE use, training, absence of work pressures, maintenance and spares and communication. Despite these limitations, the relationship between safety climate and safety behaviours remains positive in the majority of studies. The only study known to the researcher that failed to replicate this positive relationship was the one of Glendon & Litherland (2001).

2.3.6. Safety culture and injury/accident rate

The relationship between safety culture/climate and injury rate is complicated and unclear mainly as a result of the measurement issues. Different studies encompass different levels of analysis (Clarke, 2000):

- comparing two groups of employees within one company – with a high level of injury rate and with a low level of injury rate and comparing individual climate scores;
- aggregating climate scores across teams, groups and departments and comparing with injury rates;
- comparing high- and low- injury-rate companies on aggregated climate scores; and
- some studies refer to injuries (lower severity) and accidents (higher severity).

Different levels of analysis can result in different results. Another problem relates to gathering injury data. Different companies have different standards and different countries have different legal standards for reporting injuries and accidents. Thompson et al. (2007) give three reasons for which the accident rate is not a good measure of a company's safety:

- accidents are usually rare events, so the frequency of accidents can be statistically unreliable due to the restriction of variance;
- accidents are not always under the control of job incumbents;
- accidents are not always consistently recorded. Probst and Estrada (2010) demonstrated that for every reported accident there were on average 2.48 unreported accidents.

Cooper (2000) adds that these type of data ignore the different exposures to risk inherent in occupations and that this can result in under-reporting or over-reporting (see Thompson, et al., 1998).

Taking these disadvantages into consideration, Zohar (2000) introduced a new outcome criterion called "micro-accidents". This measure refers to on-the-job behaviour-dependent minor injuries requiring medical attention that meet the following criteria:

- injury was suffered during the course of work activities;
- injury was sufficiently severe to discount the possibility of an unjustified visit to the infirmary;
- injury was suffered as a result of a role-related behaviour.

Zohar listed the methodological advantages of this approach, arguing that micro-accidents:

- occur much more frequently than lost-work accidents and result in a homogeneous distribution as a function of time;
- provide an objective measure of behavioural safety unaffected by sources of bias associated with self-reporting;
- are strongly associated with lost-days accidents.

In his research, micro-accidents correlated significantly with lost-days accidents ($r=.29$, $p<.05$) and were significantly predicted by the safety climate scale (Zohar, 2000). However, the relationship between micro-accidents and major accidents is unknown and it is possible that they have different antecedents (HSE, 2002). Also, Chmiel (2005) did not find a relationship between safety climate and micro-injury rates. However, he used a different method to measure micro-injuries – a self-report injury checklist (Chmiel, 2005), whereas Zohar gathered his data with the help of medical staff from the company's infirmary (Zohar, 2000). It may be argued that independent medical examination of micro-injuries is a much stronger measure than self-reported survey, as the latter method is subject to a number of cognitive biases that may distort the results (see Chapter 7).

Despite this limitation, many more studies use self-report measures (e.g. Bjerkan, 2010; Hofmann & Stetzer, 1996; Nielsen, Rasmussen, Glasscock, & Spangenberg, 2008; Tomas, Melia, & Oliver, 1999) rather than information from companies' databases (e.g. Varonen & Mattila, 2000; Wallace, Popp, & Mondore, 2006). Also, many studies investigating the impact of safety climate on accident use different measures made up of different dimensions, and this limits the generalisability of the findings. For instance, Neal & Griffin (2006) defined and measured safety climate as the degree to which safety is valued in organisations, whereas Nielsen et al. (2008) used a Danish safety culture questionnaire composed by leadership, organisational and worker factors. Furthermore, models that seek to establish the type of relationship between safety climate and injury rate / accident rate provide inconsistent results suggesting variously, for example, that accident rate is directly predicted by safety climate (Wallace, et al., 2006) or that relationship is mediated by safety behaviour and hazards (Oliver, Cheyne, & Tomas, 2002; Tomas, et al., 1999). Despite these limitations all of the studies cited above reported a positive effect (direct or indirect) of safety climate on the injury/accident rate. However, in order to empirically evaluate these studies it will be useful to quote here a meta-study conducted by Clarke (2006), who noticed that the relationship between safety climate and accident involvement was moderated by the study design. After statistical analysis of 35 research studies she found that safety climate shows a small positive correlation with occupational accidents and injuries ($p=.22$), indicating that the more positive the safety climate, the lower the rate of injuries and accidents.

2.3.7. Conclusions

In general, the literature indicates that there is little agreement regarding the definition of the safety culture and safety climate concepts. Moreover, some studies suggest that these are just different aspects of the same phenomenon, and therefore it was decided to use these terms interchangeably in this thesis. Also, it was apparent that safety climate / culture consists of a number of dimensions and that there is similarly no shared agreement on what factors constitute the concept of safety culture. The variety of factors obtained seems to suggest that there is no one generic structure of safety climate; rather, the dimensional composition depends on the specifics of the industry sector and contextual variables of particular companies. Despite the lack of agreement on the factorial structure, the majority of studies appear to agree that the most important factor of safety climate is management engagement; however, despite the numerous research studies in the subject, it remain unclear specifically what supervisory and managerial behaviours constitute that factor.

The topic of safety culture is considered important as it is argued that it affects safety behaviours and accidents in companies. The articles reviewed seem to confirm that premise, as the majority of individual papers and meta-analyses confirm that relationship. However, the mechanism that underlies this relationship, and whether the impact of safety climate is direct or mediated by other elements, both remain unclear.

Although research is needed to clarify these unknown elements, a number of attempts have been made to influence safety climate and improve general safety in companies. The next section will discuss these attempts in more detail.

2.4. Safety culture interventions

Hybrid definitions of safety culture, such as that offered by Wiegman et al. (2002), describing it as enduring value and priority placed on safety at every level of an organisation, suggest that there may be range of ways and strategies to improve safety culture. The process of planned improvement of one or more aspects of safety performance related to perceptions of safety is called an *intervention*. Some interventions are focused on changing behaviour of line employees, others on modifying leadership behaviours and yet others on introducing a combination of socio-technical factors.

2.4.1. Behavioural based safety

One of the most popular methods of affecting safety performance (but not necessarily culture) is by changing the behaviour of particular groups of workers. This approach is widely used by the business sector and eagerly tested by academics (Geller et al., 1990; Krause, 1999; Tuncel, Lotlikar, & Salem, 2006). Different names for such methods are used in the literature: “organisational behaviour modification (O.B.Mod.)” (Pidgeon, 1998), “behaviour-based safety (BBS)” (Stajkovic & Luthans, 1997) and “antecedents, behaviour, consequences (ABC model of behaviour, ABC framework)” (DePasquale & Geller, 1999).

The theoretical foundations of this approach echo behaviourism with Thorndike's law of effect (1913), Skinner’s “principle of reinforcement” (1938), Locke’s task motivation (1982) and Latham & Lee’s goal setting (1986). Reinforcement theory links all of these human actions with environmental variables (antecedents and consequences), so that changes in environmental conditions affect behaviour and knowledge about these relationships and facilitate learning (Thorndike, 1913).

The first notes about the successful application of the ABC program that resulted in the modification of line-employees’ behaviours come from the early 1980s (Geller, 1984; Van Houten & Nau, 1983). This method has been constantly developing and today is used to change not only workers but also supervisors’ and managers’ behaviour (Krause, 2005).

The following are examples of the different methods that have been used to elicit behavioural change: 1. Goals (Marsh et al., 1995), 2. Feedback (Cooper & Philips, 1994), 3. Praise (Sigurdsson & Austin, 2006), 4. Training (Reber & Wallin, 1984), 5. Tokens (Austin, Kessler, Riccobono, & Bailey, 1997), 6. A combination of the foregoing (DeJoy, 2005). Behaviour based safety is considered fairly effective. Stajkovic & Luthans (1997), in their meta-analysis of studies evaluating behaviour-based safety interventions, indicated a significant effect of these programs on safety performance (size effect=.51). These findings were confirmed by another meta-analysis conducted by Krause et al. (1999), who analysed 73 companies that implemented behaviour-based safety programs and discovered that, on the whole, the sites involved benefited from a significant reduction in accidents compared to baseline ($t(72)=7.31$, $p<0.0001$). However, this figure may be distorted as the authors managed to obtain data from only 73 out of 229 companies identified for inclusion in the study. It may be argued that one of the reasons for not disclosing data about the effectiveness of the program's implementation was its failure in the business context, demonstrating that failure of performance is avoided due to business image and financial issues. Although this is only a hypothesis, the figures on the effectiveness of behaviour-based interventions should be interpreted with caution.

Despite these encouraging results, the behavioural approach to safety has a number of limitations. It will not be effective if employees do not have the necessary skills to perform their task safely (Sulzer-Azaroff, 1987) or if an organisation lacks requisite equipment or materials (Lingard, 1995). It often fails to involve contractors and so it does not cover all people on site (Marsh, 1995). Also, the expected level of resistance to BBS methods is high (Reber, Wallin, & Duhon, 1989). In order to reinforce safety behaviours, they need to be measured and monitored, so BBS systems tend to focus on easily visible and highly repetitive behaviours (Marsh, 2005). This may lead to missing rare behaviours or other actions that could have disastrous consequences. The majority of BBS programs do not attempt to improve managerial behaviours (Fleming & Lardner, 2002b) and if the management is not committed to the change program the failure of the intervention is very likely (Marsh et al., 1998). Furthermore, Deci (1999), in her meta-analysis of 128 studies on the effect of contingency-type rewards (like those used in the BBS programs) on intrinsic motivations, demonstrated that performance-contingent rewards significantly reduced internal motivation to perform tasks. Therefore it may be argued that BBS systems, although able to modify behaviours, may have a detrimental effect on employees' internal motivation.

2.4.2. Modifying supervisory and managerial behaviours

Despite the recognition that management is the most important factor affecting safety culture, the literature on the modification of their behaviours is almost non-existent. A unique approach to this problem was proposed by Zohar (2002, 2003). He argued that instead of analysing antecedents and consequences by an external consultant (what is usually the case in BBS systems), an effective supervisor can deliver incentives and feedback as a part of his or her daily routine (Zohar, 2002). As a result the supervisor becomes responsible for safety and his or her supervisory practice is modified. To achieve sustainable change, the role definitions of employees at all levels of the hierarchy need to be changed. In their study, conducted in an oil-refinery and canning and distribution companies, bi-weekly feedback was given to shop-floor supervisors (level-1) and their immediate superiors (level-2). The feedback evaluated reported interactions concerning safety between supervisors and their subordinates. Managers (level-2) received comparative information about their supervisors and were trained to provide information to supervisors about their relative position in terms of the adequacy and frequency of their interactions. Senior managers (level-3) also received information about the impact of supervisory practices on an operative's behaviour. This approach resulted in a change of role definition of workers and supervisors that became a self-reinforcing mechanism, sustaining change over time. This was evidenced by an observed steady increase of supervisory interactions with shop-floor workers (from 20-30% to 60-70% depending on the company), a concurrent steady decrease in unsafe behaviours (from 20-30% to 0% depending on the company) and a significant improvement in terms of safety climate after the intervention compared to the baseline.

Zohar's approach to the modification of safety behaviours is fairly new and no replication or critique was found in the available literature. However, it may be argued that Zohar's intervention addresses only one aspect of safety, i.e. supervisory and managerial safety-related behaviours, analogues to what is called in the subject literature "management engagement". As was demonstrated in the literature, safety culture concerns more factors than simply management engagement. Nevertheless, it is the only study known to the researcher that focused on changing supervisory and managerial behaviours.

2.4.3. The socio-technical approach to safety improvements

Another example of a project that focused on changing safety culture in order to reduce the accident rate was presented by Rasmussen et al. (2006). The authors considered an organisation as being a complex and adaptive environment in which physical problems are part of a wider strategy and include safety culture, psychosocial environment and managerial issues. The intervention simultaneously pursued a number of different projects related to safety. 12 groups were established responsible for subprojects focusing specifically on: chemical products, PPE, new safety instruction for chemical and physical hazards, video recording, education and learning, employee courses, proactive safety organisation, information and communication, occupational medical examination, safety rounds and team production. Each project group contained two workers, two supervisors and one to two researchers. A steering committee was established to determine the overall priorities and economic issues. A group reporting to this committee was a project coordination group. Both groups (steering committee and project coordination group) consisted of four managers, four employee representatives and two researchers. Overall responsibility was assigned to the company’s manager. Additionally, once a year the group of researchers met with the senior management to discuss the progress of the intervention and establish a plan for the following year. The intervention was preceded by ethnographic work, individual interviews and focus groups with the representatives of all levels of the hierarchy, investigating issues relevant to every sub-project group. Further, a safety culture questionnaire was developed and administered. Each group responsible for a sub-project developed its own agenda for what change was needed and its progress was measured against it. Changes involved training on new technical and psychosocial skills, production changes, job role changes and many others. The project lasted for 3.5 years. It resulted in significant improvement in safety climate scores and lost-time accidents. This approach represents a holistic approach to organisational change, in which many aspects are modified. The change process takes a long time and involves substantial resource input by the company and researchers.

Another approach to the cultural change of an organisation was presented by Fitzgerald (2005). Following the assessment of culture with an appropriate survey, which helped to identify potential issues, a meeting with the management was organised in order to discuss the results. At the meeting priorities for change were established (e.g. clarifying roles and responsibilities, hazard spotting, management engagement) and a plan was developed. The company in question rolled out a workshop program to increase awareness and win buy-in. The workshops improved reporting of near-miss incidents and the involvement of employees in auditing activities. In the next stage a safety culture survey was administered again. Based on the data obtained a new improvement plan was developed. However, the exact actions were not described in the paper. Also, data were not provided on the improvements, on the leadership engagement or on difficulties with the implementation. This is a simplified approach, in which an action plan was being developed on the basis of safety culture survey results.

A similar strategy, but with a differently designed change program, was introduced by Donald and Young (1996). Their goal was to improve attitudes towards safety. The authors organised departmental safety teams that met once a week and all members of staff were involved. Each team identified urgent safety issues and developed an action plan that was written down and team members were charged with responsibility for the plan. Additionally, action plans were developed for the management and region’s safety committee. Definitions of job roles and responsibilities were included in the plan. At every meeting of the safety committee the progress and successes were discussed. The minutes from the meetings were presented to the staff in the form of bullet points. Next, a senior manager developed a strategic action plan and visited sections of the organisation to discuss the plan with employees. Each team was provided with its own budget for resolving safety issues. In order to improve and clearly define the roles and responsibilities, a 2.5-day workshop was organised, focusing on the role of safety representatives and the role of section leaders. This intervention resulted in an improvement in attitudes towards safety, lost-time accidents, self-reported accidents and self-reported absenteeism. The limitation of the method was that safety-outcomes were measured through self-reported questionnaires, which carries a risks of bias in the results. Also, the description of the intervention did not discuss stumbling blocks and barriers during the process of implementation and such information would be extremely useful.

2.4.4. Unclassified

There are also interventions that apply more selective and narrow tools to improve safety climate. For example Thomas et al. (2005) demonstrated that an intervention that encouraged executive directors in hospitals to do a monthly walk-round improved safety climate, but not significantly. Another intervention (Nielsen, Carstensen, & Rasmussen, 2006) obliged employees to report lost-time incidents, minor incidents and near misses, assuming that this would improve the company’s ability to remove risks and hazards. The improvement in safety climate was significant.

Also, safety climate may be improved through training. Harvey, Bolam, Gregory, & Erdos (2001) demonstrated that providing a one-day training session with the object of raising general awareness of safety issues and behaviours followed by the development of the improvement plan and participation in the action prescribed brought improvement in safety climate, but only in the group of higher-grade employees. Mullen and Kelloway (2009) demonstrated that providing training to senior managers on safety-specific transformational leadership resulted in a significant improvement of safety climate.

2.4.5. Summary

The examples of interventions presented above demonstrate a variety of tools applied to achieve the goal of improvement in safety culture and some of them pride themselves on reducing the number of accidents.

2.5. General discussion

The literature review presented above helps to understand that despite the vast amount of research in organisational culture and safety culture that has been conducted to date, there is no shared agreement with regard to its very basic elements and indicators. There is an ongoing and unsettled discussion over definitions, paradigms, layers and functions of organisational and safety culture. However, new meta-studies that are beginning to emerge suggest that different names (culture vs. climate) and different paradigms are actually just different sides of the same concept. Within this hot debate, however, there are areas of agreement. It is understood that cultural indicators are not easily accessible and are rooted in the deep psychological processes of individuals. A number of approaches offer ways of accessing these, from analysing layers of culture and deducing deeper layers based on superficial indicators (Schein, 1995), to analysing the language used by employees (McDermott & O'Connor, 1996). It seems that research and insight in the safety culture arena does not go that far and confines itself to easily accessible behaviours and attitudes of employees.

Despite a history of more than 20 years of research, quantitative, survey-based methods dominate the safety culture field. Countless research papers are available in the scientific data bases, but looking at meta-analyses there is very limited agreement with regard to the composition of indicators of safety culture. In fact, the consensus is limited to only one variable, namely, management engagement, in different shapes and forms. This finding fits well with the understanding of the process of creating organisational culture described by Schein (1995), in which the founder and other leaders create and then shape the culture of their organisation. In this light, management engagement could be the only factor of safety culture. All other variables identified might just be derivatives stemming from managerial actions. This might explain the variance in the number of identified indicators of safety culture in the literature, as all of them would be context specific, dependent on local management and not generalisable to other places. Research in leadership style seems to confirm this assumption. Style is an expression of managerial assumptions and values with regard to what is important to lead an organisation successfully, and is demonstrated through a number of context-specific behaviours and attitudes that are slightly different for particular functions and levels of hierarchy (as demonstrated in the analysis of managerial and supervisory behaviours reported in the subject literature to date – Section 3.4.). It is argued that these behaviours and attitudes express norms, values and priorities, and communicate expectations to subordinates about what is desired and through that process create a frame of reference for employees' behaviours (as shown at the beginning of this chapter). Furthermore, it may be argued that managerial behaviours and attitudes shape a whole system of an organisation which is, as argued by Attwood (2006), the background for, and a source of industrial accidents and injuries.

In the light of the foregoing argumentation and evidence, accepting the assumption that leadership is the primary factor of safety culture, safety culture interventions should focus on reshaping the impact that managers have on their organisation. However, it ought to be emphasised that there is a lack of research in this field for a good reason. It is difficult to arrange such change programs in practice for a number of reasons. The nature of directors', managers' and other leaders' jobs usually require independence and creativity of them. Their responsibilities are unstructured and they are the people influencing others. This context may make behaviour-change methods irrelevant, as there are no specified behaviours to change. Rather there are guidelines to follow based on certain values and assumptions. Therefore, the approach of changing these underlying priorities requires special means; possibly psychology-based coaching. A significant number of companies offering business psychology services and executive coaching may be “real-world” evidence supporting this assumption. Nevertheless, despite the available insight, BBS methodologies dominate in practice and research and there is only a handful of papers available reporting on culture change programs other than BBS. There is even less research focused on managerial change and no study was found that focused on change of the executive/top management group. This demonstrates that safety culture interventions do not address the source of culture directly, but rather attempt to affect it indirectly.

The research and the discussion above demonstrate that there is a gap in knowledge with regard to the best ways of affecting the most important factor shaping safety culture leadership.

2.6. Critical findings

1. There is no shared agreement with regard to the definitions of “safety climate” and “safety culture”, and these terms can be used interchangeably.
2. Companies may have many cultures at the same time.
3. Culture serves as a frame of reference for behaviours.
4. “Management engagement” is the only component of safety culture reported by the majority of subject research studies.
5. “Transformational leadership” and “active-transactional leadership” are leadership styles that positively affect safety culture.
6. Different functional positions affect safety culture differently and are a source of different types of safety climate.
7. Safety culture is significantly correlated with safe behaviours and injury rates.
8. There is a wide range of tools used to improve safety culture.
9. Behaviour-based safety is the most popular change program,
10. There is no shared agreement on what is the best way to improve safety culture.
11. Further research is required in order to develop an in-depth understanding of the process of development and implementation of safety culture interventions.

Chapter 3

Methodology

3.1. Introduction

As demonstrated in Chapter 2, workplace safety culture is a facet of organisational culture (Guldenmund, 2000) and relates to the "*shared perceptions among members of an organization with regard to organizational policies, procedures, and practices.*" (Zohar, 2000, p. 587). The presence of a positive safety culture is reflected in significantly *better* safe behaviours (Clarke, 2006b) and lower injury rates (Zohar, 2000). Therefore improving safety culture has the potential to save employees' health and lives, reducing hardship to employees and their families and reducing employer overhead costs.

To date, the psychometric tradition represents the primary contribution to the research in this area, at least by volume, reflecting attempts to establish the factorial structure(s) of safety culture (Mearns, Whitaker, & Flin, 2003; O'Toole, 2002; Williamson, Feyer, Cairns, & Biancotti, 1997). Despite the fact that these studies arguably offer valuable insights into which variables are salient, the complexities and subtleties surrounding how they affect employees' orientation towards hazards and behaviour in relation to risk remain under-explored and under-articulated. It is held that insight and understanding at this level of detail is a key to the development of effective safety culture enhancement interventions.

By contrast, there are relatively few academic studies that report attempts at intervention and the enhancement of safety (Zohar & Luria, 2003), and of these, the majority are restricted to the comparatively narrow focus of changing employee behaviour (Hickman & Geller, 2003; Hudson, 2007; Saari & Nasanen, 1989; Williams & Geller, 2000). A common feature of almost all intervention studies in this area is that they appear to gather very little evidence on why interventions were successful or unsuccessful. This is held to be important as it is likely that the research evidence base in this area is contaminated by a conflagration of interventions that failed due to shortcomings in the theory of change at inception, and those that failed simply due to shortcomings in their configuration or roll out, rather than some inherent conceptual flaw. By inference, it is possible that some proportion of the transparent inconsistency in the research findings in this domain may be attributable to the relative paucity of evidence on the criteria for rolling out successful interventions.

The lack of scientific research focused on the practicalities of delivering safety improvement programs has been recognised by a number of recent authors (Wirth & Sigurdsson, 2008), but the gap in knowledge is substantial and a number of research questions must be answered within the safety domain of safety culture improvement.

This thesis aims to contribute to current knowledge by developing safety culture interventions, implementing them and reflecting on the implementation process, as well as evaluating their effectiveness. It is hoped that it will contribute to the knowledge base not only regarding the variables that shape workplace safety culture(s), but also in terms of understanding the criteria for successful implementation.

3.2. Research objectives

The aim of this thesis is to gather intelligence on the basis of volitional risk taking in the workplace and to use this insight to develop sustainable interventions that have a positive impact on safety culture. Achieving this objective will include:

1. Deriving a detailed insight on the interplay of cognitive and socio-cultural influences on employee risk-taking behaviour by investigating:
   - 1.1. the perceptions of safety-related variables of employees working in different departments at different levels of the organisational hierarchy;
   - 1.2. the distribution of these variables in a large sample of the company’s employees.
2. Reducing the incidence of employee risk-taking behaviour through:
   - 2.1. designing, implementing and evaluating safety culture enhancement initiatives;
   - 2.2. gaining insight into the process of the implementation of safety-improvement interventions.
3. Demonstrating improvements in safety performance.

3.3. Research design

Research design, in general, is a guideline indicating research strategy and informing research actions. It helps to specify what kind of evidence is to be gathered, from where, and in what ways it will be interpreted. The section below will introduce three major epistemological paradigms and justify the choice of one of them. The discussion of corresponding methodology stemming from the accepted paradigm will be introduced, and will create a background for a description of the research stages.

3.3.1. Epistemology

In the literature there are two main approaches to research on safety culture / climate: quantitative and qualitative. The former usually uses surveys and the latter uses interviews, and in the majority of cases researchers use only one approach at a time. These two approaches are the derivatives of two separate epistemological paradigms: positivist and constructivist. The word "paradigm" was introduced by Thomas Kuhn (1970), an American philosopher who interpreted it as a set of beliefs shared by a scientific community together with their accompanying methods (Lincoln & Guba, 1985). It is not a methodology, but rather a philosophy that suggests how the research is to be conducted. However, the most important is that a paradigm determines what research questions are legitimate and how they ought to be answered (Gliner & Morgan, 2000).

Supporters of the positivist paradigm state that there is a single tangible reality that can be broken down into independent variables and that can be studied independently. A researcher and the object of inquiry are independent from each other. The aim of scientific inquiry is to develop knowledge in the form of "true statements" that are independent of the time and context. Scientific inquiry is value- and bias-free due to the use of objective scientific methodology (Lincoln and Guba, 1985). However, these are just assumptions about the reality developed on the basis of historical debates of philosophers (Kuhn, 1970). Scott and Usher (1996, p. 13) comment: *"All of these assumptions have been critiqued. It could be argued for instance that in making a knowledge claim it is not simply a matter of appealing to logical and universal rules because, since all knowledge claims involve justification, they all have a social dimension. Claims are justified within contexts of collectively held conceptions about the world, and how to relate to it and know it. What we can conclude from this is that methods are embedded in commitments to particular* *versions of the world (an ontology) and ways of knowing that world (an epistemology). These commitments are always held by the researcher, mostly tacitly. This means that no method is self-validating, separable from an epistemology and an ontology."*Additionally, epistemologies, defined as ways of justifying knowledge, are culturally, historically and value-driven but the positivist approach does not recognise these limitations (Kuhn, 1970). Most importantly, the positivist paradigm almost negate the value of subjective meanings developed by research participants, what seem to be quite important in the context of researching safety culture as understanding values of particular working groups may help to modify their behaviours.

The constructivist approach is an alternative paradigm opposing the main assumption of the positivist approach. The constructivist paradigm differs from the positivist one with regard to the core assumptions about the nature of reality, the relationship between the knower and the known, the possibility of generalisation or the role of values in scientific inquiry. It states that scientific knowledge is constructed by scientists and does not derive from the world. There are multiple constructed realties. Knowledge is socially constructed and consciousness is a social construction. A researcher and an object of inquiry interact and influence each other, and are therefore inseparable. The aim of scientific inquiry is to develop working hypotheses for particular cases. Scientific inquiry is influenced by researchers' values expressed in the choice of problem, framing the problem and choosing the paradigm with which to investigate the problem (Lincoln and Guba, 1985). The constructivist paradigm brings a number of challenges that must be solved. Firstly, it may lead to relativity which in its extreme form is untenable (Gillett, 1998). Secondly it may lead to circularity of interpretations as the meaning of a research study depends on the meaning of the science and the meaning of science depends on particular studies (Scott & Usher, 1996). Furthermore, knowledge derived under this paradigm is not generalisable and never complete due to its dependency of the context. That creates a number of practical difficulties because even if one can develop some insight about a research subject it is not possible to use this knowledge in other context. The constructivist paradigm justifies and values gathering subjective, contextualised information but on the other hand it criticises collecting quantifiable results (Orlando, 1998).

Particular paradigms with their assumptions about knowledge and reality identify their preferred methods of inquiry. The positivist paradigm, with methods allowing for quantifiable results, definitely dominates the field of safety culture. Qualitative methods are used rarely and reluctantly, mainly due to the substantial amount of effort needed to analyse qualitative data. The supporters of one paradigm put themselves in a position of conflict with the supporters of the other paradigm (Reichardt & Rallis, 1994). However, House (1994) argues that the debate between the supporters of the paradigms stems from a "misunderstanding of science", as both paradigms bring valuable insights in the process of "discovering the world".

The available evidence in the safety culture arena demonstrates that the use of both the positivist paradigm (and quantitative approach) or the constructivist paradigm (and qualitative approach) are justified and offer valuable insights into different elements of constructing safety culture: individual and group meanings as well as their distribution across large samples. In this context, a decision to use only one paradigm and approach is limiting and would restrain the development of an in-depth understanding of the researched phenomenon. This argument is exceptionally strong in the light of the discussion about the relationship between climate and culture (see Chapter 2), which seems to suggest that these concepts are just the two sides of the same coin (Denison, 1996) and differentially reflect qualitative and quantitative approaches, which the majority of safety culture studies seem to avoid considering.

Gliner & Morgan (2000) suggest that the choice of method (and thus paradigm) should be based on the purpose of the research. If the aim is to identify causes or predict behaviour, then a methodology supported by the positivist view should be applied. On the other hand, if the purpose of the research is to describe the participants' beliefs fully, the methodology based on constructivism is more suitable. It is now important to remind that the objective of this thesis is to derive a detailed insight about employees' perception with regard to safety variables as well as investigating the distribution of those perceptions so a change intervention could be designed for chosen working groups. Thus, the researcher requires an approach that would combine positivist and constructivist paradigms.

The answer may be the pragmatist paradigm, which was introduced by Howe (1988). His main point was that qualitative and quantitative methods are compatible and as such researchers could use both of them in their studies. Pragmatism accepts both "objective" and "subjective" points of view. It admits that values play an important role in interpreting results. It accepts external reality and chooses explanations that best produce the desired outcomes. This tenet was later supported by Brewer and Hunter (1989), who claimed that using compatible methods required the integration of different theoretical perspectives to interpret data, and also by Reichardt and Rallis (1994), who suggested that these two paradigms and its methodologies agree with the "principle of the under determination of theory by fact". This states that any set of data can be explained by a number of theories.

The pragmatist paradigm has become more and more popular in the scientific community in recent years. Establishing the Journal of Mixed Methods Research in January 2007 may be seen as one of the indicators of the growing popularity of this approach. Pragmatism promotes applied research, suggesting that what is of interest and value to researchers should be studied in the way they deem appropriate, and the results should be used in ways that bring positive consequences within their value systems (Tashakkori & Teddlie, 1998). Pragmatically oriented theorists and researchers refer to mixed (triangulated) methodology, which contains elements of both quantitative and qualitative studies (Brewer & Hunter, 1989). Moreover, this insight is enriched by the conclusions of Denison (1996), who suggested that, as culture and climate may reflect the same reality but from different angles, the corresponding methodologies (qualitative and quantitative) historically assigned to these phenomena may in fact complement one another. Following the suggestion of Gliner & Morgan (2000), the choice of methodology should suit the purpose of the research. Therefore it is argued that a triangulated (mixed-method) methodology is likely to afford the richest insight into the set of variables affecting safety culture / climate, and as such would be the preferred choice of over a purely qualitative or quantitative approach.

3.3.2. Triangulation methodology

The term "triangulation" comes from Denzin (1978) and originally referred to a nautical process in which two points and their angles were used to determine the unknown distance to a third point. Denzin's approach used different data sources to study the same phenomenon. A year later, Jick (1979) discussed "within-method triangulation" using multiple quantitative or qualitative research methods for the same research, and "across-methods triangulation", was mixed qualitative and quantitative means of investigation in the same study.

Triangulation is a research approach that recommends using two or three different methodologies and study designs in order to double- or triple-check results and avoid the methodological limitations associated with single approaches. Triangulation usually mixes qualitative and quantitative methodologies. Glendon & Stanton (2000) cautioned that there are not many studies that implement triangulated methodologies and advances are required in this arena. This approach allows for a multi-level analysis of safety culture by conducting interviews, surveys, audits and document analysis (Choudhry, et al., 2007).

In response to the methodological gaps in the literature with respect to justifying the use of mixed methodologies, Bailey and Hutter (2008) offered a linked trajectory of method triangulation (LTMT). Their technique seeks to combine two methodologies, starting with gathering qualitative data to get in-depth, contextualised insights and subsequently quantifying the results by developing and administering a survey on a large sample of respondents.

Following the recognised limitations of using only one paradigm in research (House, 1994) and the benefits of a mixed-methodology approach in the pragmatist paradigm (Feilzer, 2010), it was decided to develop a triangulated approach to research in this thesis and to combine a number of different methods. The decision was also supported by the suggestion of applying triangulation within the safety culture domain (Glendon & Stanton, 2000), supported by the evidence of successful application of mixed methodologies (Bailey & Hutter, 2008).

3.3.3. The uniqueness of the Ph.D. project

In contrast to the mainstream psychometric tradition that dominates safety culture research, this study used an embedded approach. The researcher was located within the study organisation for three years. This degree of embeddedness offered an opportunity for what is thought to be a unique (in the safety culture field) level of exposure to the socio-technical complexities that characterise how risk is understood and reacted to by employees. The researcher presented himself to the management as a Ph.D. student whose task was to develop tools to develop the company’s safety culture further. The sponsor company used to sponsor students in the past and it was a common practice. There was an important consequence of being a student within this organisation – it meant not having authority, either formal or informal. Formal authority was linked to the position occupied in a company and the amount of power that could be exercised over others. The informal authority was linked to the respect given by others due to knowledge or other attributes that were important within a given group. The difficulty of the researcher was that he did not have any of these; the researcher was not even an employee of the sponsor's company. Furthermore, the researcher's role was not clarified formally at the beginning, making it vague to all parties. The researcher was perceived by the management as somebody working for an external institution with his own agenda and who should not be engaged in operational routines. Furthermore, at the beginning of the studentship the researcher was unfamiliar with the concept of safety culture and so could not serve as a trusted advisor on this matter. The role of the researcher was not clearly described. On the one hand it provided an opportunity to the researcher to define the role in cooperation with others; on the other hand it created confusion about the nature of the cooperation between the researcher, the university and the sponsor company. However, despite the aforementioned challenges the embedded approach permitted an exploration of the micro-political and cultural aspects that are at risk of being obscured where more distal investigatory methods are applied.

This approach was initially inspired by Beynon (1984), who, having had an opportunity to conduct a survey in one of Ford's factories, was given access to the internal environment of this car production company. He described the shop floor and relations with management vividly, providing an extensive contextualised insight on the conflicts between workers, what bonds them, relations with stewards, apathy and contempt. Beynon demonstrated how rich the picture of employee relations can be if studied from within a company's environment.

Furthermore, having a desk in the company offered a unique opportunity of access to the representatives of all functional positions in all the company's locations (buildings, departments, cells and lines) and allowed for the application of the mixed methodology discussed in the previous section. It allowed for an ethnographic approach to be undertaken by spending much time on the shop floor with people working physically (Brooks, 2005, 2008; Walker, 2010). It also allowed for the analysis of safety-related documentation (Richter & Koch, 2004). It also provided an opportunity for informal conversations and individual interviews with shop-floor employees (Naevestad, 2008; Parker, Lawrie, & Hudson, 2006) and with senior management (Gyi, Gibb, & Haslam, 1999). Furthermore, it allowed for group interviews to be organised (Jeffcott, et al., 2006), followed by a safety culture survey (Cox & Cheyne, 2000).

This embedded perspective is based on the premise that sustainable safety improvement interventions benefit from being bespoke and rooted in contextualised insight (Jeffcott, et al., 2006; Weyman, Pidgeon, Walls, & Horlick-Jones, 2006).

The methodological trajectory of this thesis was influenced by a recognition of a plateau in the research findings in the field of safety culture, in particular psychometric findings, the limited consensus among studies over key variables and insights from relatively recent qualitative studies that highlight the importance of context (Pidgeon, Walls, Weyman, & Horlick-Jones, 2003). Other influences relate to the socio-political context in the UK and discussions over the best approach to the application of academic knowledge in practice (Boud & Solomon, 2001). For example, “work-based learning” is said to highlight an array of benefits associated with conducting research in a position embedded in the work environment of the study population (Garrick & Rhodes, 2000).

To summarise, the embedded approach applied in this thesis was inspired by past research and public discussions over the best approach to education, and was justified by the goal of triangulated methodology allowing for in-depth insight into the variables affecting employees’ behaviours and attitudes.

3.3.4. Stages of research

This section will provide an overview of a range of activities undertaken in order to achieve the research objectives. In general, this Ph.D. study was carried out in four main stages: background research, familiarisation with the company, deriving insight about perceptions towards safety (focus groups) and its distribution across departments and functional positions (safety culture questionnaire), developing, implementing and evaluating safety interventions.

Phase 1: Background research (Chapters 2 and 3)

- literature review,
- identification of the core safety culture components discussed in the literature,
- identification of a set of variables affecting safety culture,
- developing the research strategy.

Phase 2: Familiarisation with the company (Chapter 4)

- unstructured interviews with the sample of employees (N=69),
- non-participant observations in production departments,
- analysis of safety documentation,
- analysis of past surveys,
- analysis of past safety interventions.

Phase 3: Investigating perceptions of safety and its distribution (Chapters 5 and 6)

- focus groups
    - developing a question set based on insights from the literature and process of familiarisation,
    - organising pilot discussion ,
    - organising focus groups,
        - N=6 with the operatives,
        - N=1 with supervisors,
        - N=1 with managers,
    - analysis of data.
- safety culture questionnaire
    - analysing and comparing insights from:
        - the literature review,
        - the process of familiarisation,
        - focus groups,
    - developing item pool,
    - piloting the survey,
    - administering the questionnaire,
        - N=443 in 2008,
        - N=227 in 2009,
    - data analysis.

Phase 4: Developing, implementing and evaluating safety culture enhancement interventions (Chapters 7 and 8)

- Intervention 1
    - identification of the research sample,

- identification of the tool measuring safety culture and related variables,
- developing safety behaviours observational checklist,
- developing the intervention model,
- administering pre-test measures,
- implementation of the intervention,
- investigating the reasons for the failure of the intervention,
  - conducting individual interviews with intervention participants,
  - conducting phone interviews with external safety experts,
- analysis of the interviews results.

- Intervention 2:
  - identification of the research sample,
  - identification of the tool gauging safety culture and related variables,
  - developing safety behaviours observational checklist,
  - developing the intervention model,
  - administering pre-test measures,
  - implementation of the intervention,
  - administering post-test measures,
  - analysis of data.

Chapter 4

Familiarisation with the Sponsor Company

4.1. Introduction

A primary aim of this Ph.D. thesis was to explore the variables that affect safety culture(s) at the company, with a view to developing effective safety culture improvement interventions.

The research in this project was limited to one large organisation. All methods that were developed as part of this Ph.D. sought to aid in making changes in that specific context. Therefore the first question that was asked was: “What is the safety culture of the company” or potentially “What are the company’s safety cultures” if more than one were found. This was also the research question of data-collection stage of this Ph.D. (Chapters 4 - 6), which sought to familiarise the researcher with the phenomenon he intended to modify.

There is some evidence in the safety culture literature that people’s perceptions of safety (as one of an array of variables that impact on behavioural norms) affect safe behaviours (Clarke, 2006b), indirectly having an impact on accident rates. Based on that information, it was assumed that through the modification of perceptions (safety culture) it was possible to impact risk-taking behaviours, which was at the centre of the attention of the company sponsoring this project.

4.1.1. Aim

To gain a contextualised, grounded insight into the nature and socio-technical context of work at the company.

4.1.2. Objectives

1. To gain an appreciation of:

a. the physical and managerial structure,

b. the array of production processes and technical systems in each department at the site, i.e. production processes, technologies and human-machine interaction,

c. the principal job roles and tasks performed by personnel within production departments.

2. The principal hazards and risks associated with the production processes.

4.2. Method

A mixed-methods approach was adopted on the grounds that the complementary use of a range of data types would maximise insight and appreciation of the complexities of the subject matter (Marshall & Rossman, 1998) (see Chapter 3).

It was important for the researcher to familiarise himself simultaneously with the range of activities undertaken by the company as well as with its history in the areas relevant for the research. Two approaches were undertaken: active and passive. The passive one focused on the familiarisation with different types of documentation, including safety policies and procedures, the analysis of past safety interventions and the results of surveys conducted in the past. The active approach involved a combination of participative activities used with a view to gaining an in-depth, contextualised understanding of the organisation, its socio-technical systems, hazards and staff orientations to associated risks (Patton, 1990). This included participating in management meetings, observation of the production processes and unstructured interviews with employees. During this process a research diary was kept.

The following sections will describe in more detail the familiarisation activities undertaken by the researcher, discussing the passive analysis first, followed by the active analyses. These stages were conducted simultaneously and they complemented each other.

4.3. Familiarisation with safety documentation

The written safety documentation of the sponsor company contained a wide range of information that guided the management and employees in their daily tasks and set a framework for decision making when dealing with safety issues. From the legal point of view, the organisation was obliged to develop and keep certain safety documents, which will be described in the following subsections.

4.3.1. A Health and Safety Policy

A Health and Safety Policy is a plan detailing how the company is going to manage Health and Safety issues. It is a unique document for every company and usually consists of three sections:

1. The “statement of intent” section sets out the company’s commitment to managing Health and Safety effectively.
2. The “organisation” section states who is responsible for what.
3. The “arrangements” section contains the detail of what the company is going to do in practice to achieve the aims set out in its statement of intent.

As the company belongs to a multinational corporation, which was an American company, the main safety documentation was prepared by headquarters based on the requirements of OSHA (Occupational Health and Safety Administration), which is the American counterpart of British HSE (Health and Safety Executive). These documents were then interpreted and adapted by the business groups i.e. factories specialised in the production of similar products. Finally, their documents were interpreted by particular sites in different countries with special attention paid to the local and international (EU & ISO) safety requirements. The company interpreted corporate safety documentation and adapted it to the UK safety law and context of the site. A discussion of the content of the company’s extensive safety documentation is beyond the scope of this thesis, but the interpretation of the function of the extensive safety procedures will be provided in the discussion section at the end of this chapter.

4.3.2. Accident database

An accident database was managed by the sponsor company independently of other companies belonging to the same corporation, and it includes all reported injuries and accidents. All accidents and injuries (including RIDDOR - Reporting of Injuries, Diseases and Dangerous Occurrences Regulations - but excluding near misses) had to be reported to the headquarters using two means: updating an online corporate database of accidents and sending summarised reports on a monthly basis. The accident rate in the company was presented in Chapter 1. The accident statistics show that the rate of accidents and injuries was declining with every year. Although no hard evidence is available, that may be due to a number of safety-focused interventions undertaken since the corporation bought the sponsor company.

4.4. Analysis of past safety interventions

4.4.1. Interventions introduced by corporate management

The information about past safety interventions was based on the verbal accounts of the safety team members. It is believed that no safety intervention was introduced by corporate management other than the three described below. The information about past safety interventions was based on the verbal accounts of the safety team members (N=4) collected during individual interviews (N=4).

Assessment in Motion (AIM)

The program was introduced in 2005 and lasted about 2 years. Health and Safety officers trained a number of representatives from chosen departments. These individuals were responsible for the assessment of machinery guards and working behaviour in order to identify hazards that could potentially damage hands or fingers. They used assessment forms and risk assessment tools. The aim of their work was to suggest solutions and if necessary, to raise a ticket to engage maintenance help.

Red Flag Program

The main goal of this intervention was to engage the employees on an ongoing basis to detect hazards and raise tickets to maintenance in order to remove them. The program was introduced in the summer of 2005 and was closed in the winter of the same year. The program followed a number of steps:

1. Health and Safety officers trained a handful of workers (appointed by department supervisors) from every department,
2. individuals were asked to identify hazards in the working areas they were familiar with,
3. individuals filled out a report form and forwarded it to the Health and Safety department in order to enter it into a database,

4. individuals hung a “red flag” on or near the hazardous place/element. The note included basic information about the reporter and the nature of the hazard.

In comparison with AIM, this program focused on a wide range of hazards, including but not limited to hands and fingers.

Injury Free Event (IFE)

This program aimed to engage all workers to report near misses and unsafe behaviours. Mini-books containing short reporting forms were handed out to all employees. The idea behind this intervention is based on Heinrich’s concept of the safety triangle (1954), later tested and verified by Bird & Germain (Bird & Germain, 1997), which described the relative frequency of near misses, property damage incidents, minor injuries and major injury, in a ratio of 600:30:10:1 respectively. It means that for every 600 near misses, ten minor injuries and one major injury occur (Bird & Germain, 1997). Thus, the number of near misses can be used as a diagnostic tool predicting major injuries.

The program was implemented in the following stages:

1. all supervisors from all departments were trained in what the initiative was about, and in how to use and fill out the mini-IFE book,
2. supervisors were obliged to provide training to all of their subordinates and distribute mini-IFE books, one for every employee,
3. a special data base, separate for every department, was prepared to allow the gathering of the reported information and help departmental managers to keep a record of what was resolved.

As far as the researcher was aware, no systematic evaluation was undertaken of any of these methods. The commentaries about the programs were obtained from verbal accounts of the safety team. In an applied, pragmatic context of business, usefulness and perceived benefit were used as evaluative criteria. The AIM program was perceived as effective but simply petered out. The reason provided by the safety team members was the lack of managerial ownership. The red flag program helped to identify and remove many hazards but was abandoned after about six months. Employees identified hazards with visible “flags”, but as the company failed to resolve many of them, they were still hanging 12 months after the first notice, causing the frustration of employees. The IFE program is still ongoing. Again, based on the verbal accounts of the safety team members, it was suggested that the systematic evaluation of these programs was not undertaken due to alack of knowledge (how) and resources (who).

4.4.2. Interventions introduced by the local management

Local Safety Teams (LST)

LST describes an initiative run from 2004 to 2006 in which every department had a group of volunteers that consisted of two line employees; one supervisor was chosen in order to detect hazards on a weekly basis and raise maintenance tickets (an internal tool of the maintenance department used to queue and prioritise tasks to do, reported by employees from other departments). The participants in this program were trained in hazard detection by the Health and Safety officers.

The were several differences between this program and the Red Flag programme. Firstly, LST started earlier and was introduced by the local management. Red Flag was developed by an independent management group and implemented on site in South Western England. Further, the small LST team involved supervisors, whereas the Red Flag program was aimed only at shop-floor employees. Finally, the reporting systems of identified hazards were different.

Tactical Safety Teams (TST)

This program was an answer to the high number of accidents that occurred in 2001 (about 750 incidents). It was initiated in 2002 by the plant manager and was completed in 2004. The main goal of this intervention was to improve discipline in the auditing of hazards and make managers responsible for safety. In every department one team was created and a departmental manager was responsible for selecting its members. The initiative was driven top-down in collaboration with the HR department. It included weekly safety audits and raising maintenance tickets. Every two weeks all intervention participants gathered for a summary meeting and particular teams presented the results of their work in front of other teams. According to a manager overseeing this program, shared events helped to maintain a high level of motivation and responsibility. In 2004 a person responsible for the intervention was replaced and the new leader was not able to maintain the program efficiently. The number of accidents decreased from 750 in 2001 to about 300 in 2004. This improvement was attributed by the management to the intervention described above, but no rigorous systematic evidence was collected that could support the connection.

4.5. Familiarisation with the results of past surveys

There were two major surveys conducted at the company that sought to gather opinions from the majority of employees. The first one was called "People skills" and was administered in 2003 and 2004. The second one, "Global Voices", has been administered once a year ever since 2006.

4.5.1. People skills

The initiative was started by the general manager of the plant and the Human Resources department. It aimed to identify the training needs of supervisors and managers relating to people-management and team-leading skills. An external company was asked to conduct 40 individual interviews to gather employees' views on the company's operations. The 40 individuals were chosen on an opportunity basis to provide a spread of perspectives from a range of departments. The demographic information about the sample was not available. The information about the reasons for the small sample was not provided in the report created by the consultants, so only speculative answers can be provided. Potentially, the managers recognised the need to assess their people skills (hence the survey) as they might have suspected this aspect of their performance was causing some tensions / conflict with the workforce. It is plausible that this conflict was responsible for the small sample, but this is just speculation. The interviews were followed by a survey targeted at all employees. The researcher did not have access to the questions asked during the interviews or to the results of the analysis of the interviews.

Following the qualitative work, a pen-and-paper survey was administered, consisting of 57 questions relating to the business processes, management, communication, motivation and decision making. Additionally, there were questions that sought to gather opinions about possible improvements in the future. The response rate to the survey was approximately 10%. The table below shows[4] the results from the survey obtained in 2004. The answers to these questions were on a binary scale (Yes / No). The survey included two open questions ("Q10 How well

[4] Approval was granted by the quality department manager (on 08.06.2010) to quote the results from the 'People Skills' Survey in this thesis.

does your team work together to achieve objectives 1-5" and "Q13 How do you feel about working for the company?") to which the respondents had to write down their answer. The written answers were grouped into three categories: positive, mixed and negative. The values in the table represent the percentage of "Yes" answers given by the respondents. The questions were sorted in ascending order.

Table 3. *Question set from the "People Skills" survey*

Questions from the survey	2004
Q24 Do you think your efforts at work are appropriately rewarded?	23
Q26 Is communication good in the company?	27
Q18 Do you feel valued and respected by the company?	32
Q23 Is the manager above them effective?	32
Q27 Are you involved in decision making?	39
Q28 Do you have input into decisions which affect your job?	40
Q22 Is your immediate line manager effective?	41
Q19 Do you feel valued and respected by your line manager?	48
Q16 Do you feel professionally safe at the company?	55
Q15 Do you feel emotionally safe at the company?	58
Q9 Would you say your team achieves or exceeds your objectives?	62
Q29 Do you feel free and able to offer suggestions on issues or for improvements?	63
Q4 Have you received any on-going support and/or training for this role?	64
Q11 Is your team effective?	66
Q5 Do you have a job description for your present role?	69
Q8 Do you know what they are?	71
Q7 Does your team have any objectives?	74
Q2 Is your present role clear?	75
Q14 Do you feel physically safe at the company?	76
Q3 Have you received any training before starting your present role?	81
Q20 Do you feel valued and respected by your colleagues?	82
Q31 Do you feel accountable as a member of your team?	82
Q30 Do you feel accountable for what you do at work?	87
Q6 Are you a member of a team?	92

The five worst items referred to communication, rewarding efforts, respect from the company and managers, being involved in decision making and low perceived managerial effectiveness. The top five items regarded the feeling of belonging to a team, respect from colleagues, training and accountability. These results indicate that in 2004, the biggest issue for most employees was communication and the people skills of managers (involvement and respect), which were perceived to be unsatisfactory. On other hand, strong identification with team members and feelings of accountability for performed tasks were perceived the most positively.

4.5.2. Global voices

"Global voices" was a survey managed by an external company, but unlike the "People Skills" survey, which was administered only locally, it was conducted globally, in all of the corporation's locations.

The objectives of the survey were to[5] understand the level of engagement of the employees worldwide, encourage joint employee-manager communications, embed values and competencies into the corporate culture and promote an awareness of the corporate objectives and initiatives.

A corporate team from many businesses and regions worked to develop the survey questions, which were customised to the corporation's values and objectives. There are a total of 32 questions in addition to pre-selected demographic items. Questions are divided into 10 categories. The results are indicated in the form of the percentage of favourable responses[6]. Table 4 below shows the results of the company in the last four years in ten dimensions.

Table 4. *"Global voices" survey results from 2006 to 2009*

Dimension	2006	2007	2008	2009
Employee engagement	38	42	32	33
Management effectiveness	37	42	40	43
Leadership / Vision	32	36	27	26
Communication	33	38	36	42
Growth and Development	35	38	37	39
Involvement and Belonging	37	38	38	43
Recognition	22	26	26	31
Quality	51	46	44	48
Safety	58	57	55	53
Working Conditions	32	39	30	30

The survey results in the table above indicate that the majority of the dimensions were rated fairly low by the employees. It means that the employees at the sponsor company expressed negative perceptions about a variety of elements of organisational performance. The highest scores were given to quality and safety, the lowest to recognition. This suggests that the employees appreciated the effort of the company to prioritise safety and quality, but were most unhappy with the perceived lack of respect and poor working conditions. The data are limited only to percentages and no statistical analysis results were available.

[5] As stated in the survey documentation

[6] Percent Favourable - This is the percent of employees who responded "Agree" or "Strongly Agree" and / or "Rarely" and "Never" (a combination of the top two most positive responses) to the survey item within the report grouping.

4.6. Safety management meetings

Being physically embedded within the company, and nested within the Health and Safety resources function for this and subsequent studies, provided an opportunity to gain a detailed appreciation of managerial orientations and practices on a daily basis. In addition to daily interactions with safety professionals and senior staff within the organisation, participatory activity included attendance at safety management meetings (N =10) that took place every day (for the discussion of daily issues) and monthly (for the discussion of strategic issues). This activity fostered the development of trust between employees and managers and an overview of the daily problems they faced at the time. The presence of the researcher at the meetings also communicated to management the support of the Health and Safety manager for the researcher. The developed trust was perceived by the researcher as an essential quality in the further cooperation with the management, helping it to communicate more openly and honestly.

4.7. Observations

The company had 52 departments with about 1000 employees working there in 2007 on two or three shift patterns. Observations of working practices were conducted in the majority of the production departments (e.g. Wax Moulds Production, Monoshell, Foundry, Large Finishing, Small Finishing, X-ray, EDM, Ceramic Core Production, Alloy Production). A number of observations in each were conducted. The observations aimed at familiarising the researcher with the work environments specific to particular departments. The researcher first needed to know the spatial arrangements of the particular divisions (where he could or could not go by himself), the machinery and the associated risks (e.g. not to go closer than 1m to a large furnace), the tasks employees were conducting and the associated risks (e.g. burns in the Large Wax department or cuts in the Large Finishing department), the equipment and tools used by employees, the role of particular organisational sections in the production process, the interactions between employees (content and quality) and technical aspects of the production process (materials used, processes applied). The observation schedule was not used, as access to particular areas was dependent on the availability of supervisors or other people who were able to devote the time to walk round with the researcher. The collected data consisted of information gathered about the aforementioned topics, supplemented by the researcher’s impressions about the interactions between employees and associated feelings. The data would not inform the research design, but rather were used as a means of inspiration and reflection on the challenges of working in this environment. Usually a departmental supervisor was asked to delegate an informed person to provide a guided walk through the department. It allowed questions to be asked, and an interactive style of learning. Every visit lasted 30-120 minutes. Information was written down in a research diary immediately after each visit. That activity helped the researcher to develop a better understanding of the work environment he was placed in.

4.8. Individual interviews

The shop-floor observations were supplemented with unstructured interviews with production staff and their supervisors (N = 69) with a view to eliciting clarifications of job roles, task elements and an initial insight into employees' perspectives of hazards and risks. At this stage, unstructured, informal interaction was considered more appropriate than semi-structured or structured interviews, in view of the researcher's limited insight into the subject matter at this stage, and of the potential for more rigid approaches to restrict the breadth and scope of emergent topics and issues.

4.8.1. Procedure

The interviews with shop-floor staff were designed to be unstructured in order to make the encounter as natural and uninhibited possible. Interviews were conducted with shop-floor operatives and front-line supervisors and managers. All interviews were with individuals and although conducted on the shop-floor, they benefited from the content of the conversation being masked by the background noise. All interviewees were volunteers, informed of the purpose of the research and offered assurance that any responses would be treated as confidential and not disclosed to their employer or any other party in an attributable form.

The researcher's early interactions with employees suggested that there was a low level of trust between the management and shop-floor employees. In this context the researcher did not want to be perceived as part of the management, as this could prevent access to vital information. Therefore, in order to elicit as much information as possible, the researcher presented himself to the employees as a Ph.D. student working for the university, trying to understand their struggles better. The researcher adopted two main strategies for developing trust and rapport. The first one was to avoid being perceived as part of the company's management. The second one required spending time with the participants during their work or during breaks and having many conversations on many different topics, which would reassure them that the information they share with the researcher would not be passed to the management in a form that would allow the identification of individuals. This strategy appeared to be successful and many trustful relationships were developed, but the downside of being perceived as a researcher was not being a part of management and not having influence on managerial decisions.

While consideration was given to the use of video and audio recording during interactions with staff, it was felt that the methodological advantages that this might offer were outweighed by the need to enhance rapport and trust between the researcher and employees at this early stage in the research. Additionally, it was felt that interviews should not be structured in order to:

- encourage a natural flow of conversation,
- evoke terms and terminology used naturally by employees,
- allow interviewees to lead the conversation to let them talk about the matters that are most important to them.

Each interview commenced with a "naïve" ethnographic question, of the type: "What is it like to work for this company?" A research diary was used to keep a record of each interview. Diary entries were made immediately after each interview in order to minimise the risk of losing data. The diary was also used to record inferences drawn, ideas for future exploration and the proceedings of safety meetings and other significant events or changes at the site during the course of the study. There was no interview schedule. The aim of the conversations was to explore the aspects important to employees without structuring the conversation. Therefore the topics covered a variety of aspects related to working for the sponsor company that were important for particular individuals. The interviews were conducted on a convenience basis. The interviews were dependent on the availability of the employees. Due to the nature of the interviews conducted on the shop floor, the content of the conversations was noted in a research diary and no verbatim data were collected. As this was a preliminary study of the range of subjects for subsequent more in-depth exploration, the analysis of the research diary content did not differentiate between the operatives and managers – all were treated equally. Furthermore, the shop-floor operatives constituted 85% of the interviewed sample and provided the majority of information for the analysis. The exploration of the differences between different grades was conducted as part of the focus groups (see Chapter 5).

While the approach to data gathering and recording in this initial study may be open to criticism, in particular with regard to the approach to recording responses through reflective field notes, rather than using audio recordings, the approach adopted reflects two considerations: (i) the desire to minimise any artificiality in these initial interactions between the researcher and workers at the site (in particular it was important to build rapport and trust with employees) and (ii) the nature of permissions that the researcher had from senior managers when gathering this data, were limited to familiarisation with socio-technical systems, while avoiding causing significant disruption to work activity.

While, the intent was that this initial familiarisation phase of the research should focus on technical aspects of plant operations, it quickly became apparent that there was useful data emerging from these conversations, and that many details would be lost if not written down. Therefore a reflective research diary was used to capture as many details recalled from the conversations as possible.

The early period of this Ph.D. project was crucial for the research in terms of building trust, both amongst employees and senior managers. Gaining the trust of senior managers, e.g. through minimising disruption to production, was seen as key to them permissioning later stages of the research. As the researcher was not an employee of the sponsor organisation, the good will of the employees and management was perhaps the most important factor allowing the research to take place. Failure to achieve this could have critically undermined the research.

In essence, the approach adopted in the initial familiarisation data gathering phase resembled that adopted by Beynon's (1984). Beynon's approach to interacting with employees was not driven by a schedule; he was instead adapting to constantly changing social interactions and his interviews with Ford's employees were part of hours of informal conversations he had with them in a variety of settings.

It was felt that the benefits associated with relationship building and winning trust outweighed the methodological shortcomings, particularly as more formal and rigorous approaches were planned for later stages of the research. The main limitations were related to the lack of verbatim recording of responses, a lack of structure that minimised the scope for comparability, and limited information about the demographics.

It can also be argued that there were advantages to adopting a very informal approach, particularly in the early stages of a project where salient features may be unknown to the researcher. Interview schedules tend to work like a filter, tending to limit responses to the topics identified by the researcher (most likely from the subject literature), which may limit the opportunity freely to explore the topics important to people working in this organisation. Not structuring the approach to the interviews gave the researcher the advantage of asking questions that could not have been predicted and that stemmed from the discussed topics. This exploratory approach was not used for all stages of the research, and more formal group interviews were organised as a subsequent stage of the research to explore the discovered topics in a more systematic fashion. Additionally, in the context of this particular study, the term ‘interview’ can be misleading. It conveys the meaning of a formal interaction between two parties, whereas in the context of this research it is used to describe informal conversations about things that were important to the employees.

4.8.2. Sample

The interviewees were approached on an opportunity basis, with care taken to reflect a representative array of job types and production tasks. There were a number of restrictions to sampling:

1. the researcher could not interrupt production processes,
2. the researcher could only engage on an individual basis, so as to avoid disturbing other employees,
3. the researcher needed to avoid creating any health or safety risks by engaging with staff while they were performing hazardous tasks.

The interviews were conducted from September 2007 to April 2008 and each lasted between 15 and 60 minutes. A breakdown of the sample by department and grade is given in Table 5.

Table 5. *Breakdown of the sample by department*

Department	No of operatives	No of managers
Wax room	9	4

Monoshell	6	2
Mould Preparation	6	1
Foundry	10	1
Cleaning	4	1
X-ray/Dispatch	4	1
Ceramic Core	4	1
Other[7]	5	N/A
TOTAL	58	11

4.8.3. Choice of method of analysis

Thematic analysis was considered the most appropriate method for this study. The rationale for this was based on the fundamentally constructivist paradigm (discussed in more detail in Chapter 3) and on the nature of the data that could be gathered in the shop-floor context. Moreover, thematic analysis was considered to offer data at an appropriate level of detail with respect to the primary purpose of the study, which was to develop an insight and understanding of the context of the study and highlighting phenomena for subsequent more in-depth analysis using more structured approaches.

4.8.4. Process of analysis

The analysis of the research diary followed the five steps suggested by Braun & Clarke (2006).

Step 1. Familiarisation with the data.

Familiarisation with the data began at the stage of writing notes in the research diary. At the very beginning careful reflection on the content of the interviews was performed. During this initial stage of analysis diary notes were read and re-read.

Step 2. Generating initial codes.

The aim of this process was to attach short descriptors/labels (codes) to short, meaningful chunks of data from the diary. Meaningful pieces of text (sentences/paragraphs) were given short labels identifying the content of the particular fragment.

Step 3. Searching for themes.

The set of initial codes and their definitions were reviewed and searched for similarities and overlaps. Where equivalence and overlap was significant

[7] The researcher also conducted interviews with people not directly involved in the production process and shop floor: with H&S representatives, Polish contractors working full time for the company and with the director of the Union.

consideration was given to merging these as constituent facets of higher order codes or themes.

Step 4. Reviewing themes.

All quotations that shared the same codes were collected together. The themes and quotations that related to each one were then reviewed in search for any inconsistencies.

Step 5. Defining and naming the themes

Groups of similar quotations were described. This process provided the definitions. Based on the definitions, the names for particular themes were chosen.

4.8.5. Results

The interviews provided a rich insight into employees' commentaries on workplace safety and broader perspectives of employment in the organisation. In many instances safety issues were, perhaps unsurprisingly, embedded within broader orientations. A substantial group of comments referred to the actions and engagement of management. Following the literature, all of these sentiments could be combined and entitled "management engagement", as in the majority of the subject literature (Hahn & Murphy, 2007; Mearns, Flin, Gordon, & Fleming, 2001; Mohamed, 2003; Prussia, Brown, & Willis, 2003; Silva, Lima, & Baptista, 2004; Thompson, et al., 1998); however, it was decided not to select this method as dividing "management engagement" into more detailed categories (themes) better reflected the complexity of social and organisational interactions.

COMMUNICATION

Reports of barriers to the flow of information were widespread and multi-faceted. Moreover, it was apparent that the interviewees had clear expectations regarding what should happen and what would help them to perform their work. A recurrent and widely held perspective was that employees do not receive sufficient, appropriate or timely information on a whole range of issues. Cited examples included restricted or delayed access to more senior staff when pressing production (including safety) issues arise; additionally, it was apparent that there was little confidence in the provision for forwarding shop-floor concerns to higher levels within the organisation, or in the positive benefits arising from the issues raised by workers.

COMMUNICATION - Staff meetings

The following sentiments were expressed with respect to the shop-floor staff meetings. These meetings reflect official company policy and are intended to provide a conduit for information to flow up and down the organisation via supervisors and line managers. Sentiments expressed by both shop-floor operatives and supervisors or line managers were that there was limited confidence in the system, to the extent that questions are raised with respect to the utility of this process.

Operative sentiments were characterised by limited confidence that their concerns would be addressed and worries that raising safety concerns would not meet the expected attention of supervisors (see: "people skills of leaders" theme). Supervisors transparently saw little value in these meetings, citing the fact that workers neither raise nor discuss any problems. Moreover, this culture of disengagement was said to be self-perpetuating, inhibiting the preparedness of new-recruits to engage in discourse. As a consequence, supervisor and line manager motivation to promote and engage with the staff-meeting process appeared limited.

COMMUNICATION - Shift handover

Effective communication between supervisors and line managers at the point of a changeover is necessary to exchange critical precaution or quality information and also to raise awareness of any safety issues that may have arisen during the previous shift. In theory, a supervisor from shift A should gather information from supervisor B from a previous shift and then pass any relevant elements of this information to the operatives on the current shift. While it was not possible to verify the effectiveness of this process, it was widely held by employees that this is not happening to a satisfactory extent. The implications of this negligence could affect both production and safety. It also caused frustration as operators claimed that weak communication at shift handover makes their job more difficult; for example, they had to spend more time at the beginning of their shift trying to figure out what the previous shift did.

COMMUNICATION - Coherence

There were a number of managers in each department responsible for different aspects of the production process e.g. quality, scrap management, quantity, engineering improvements, machinery, maintenance and others. Employees reported that they received contradictory orders from different managers. This insight suggests that employees believed and experienced that there was poor communication at the managerial level between different departments.

COMMUNICATION - Performance feedback

A further aspect of communication mentioned by employees was not getting feedback on their performance either from supervisors and managers. It was important to employees, to know how they are doing, how are they being perceived by their leaders, both in general and in comparison to other co-workers. Feedback on performance is an important element of communication. It may be used as a source of both praise and corrections. Moreover, interactions between a leader (supervisors / manager) and a line employee aimed at the provision of feedback may serve as an opportunity to exchange other information (including personal interest), ask questions, raise problems etc. It has already been demonstrated in the literature that providing feedback may improve safety (Blackmon & Gramopadhye, 1995), safe behaviour (Marsh, et al., 1995), working conditions and ergonomics (Laitinen, Saari, & Kuusela, 1997)

COMMUNICATION - Leaders not communicating their actions

This sub-theme refers to situations in which an initiative was undertaken by the line employees in order to identify hazards, report unsafe working conditions or communicate near-miss incidents. The impression expressed by interviewees was that after they report an issue, they receive no feedback on what is being done about the issue raised, so even if the leaders did their best to remove a problem, workers would not know about it. Also, it is probable that failing to communicate the actions taken may be perceived as management disregard, thereby causing employee disengagement.

PEOPLE SKILLS OF LEADERS

People skills were defined by Rifkin (2002) as: (a) understanding oneself and moderating one’s responses, (b) talking effectively and empathising accurately, and (c) building relationships of trust, respect and productive interactions. This theme refers to the operatives’ perceptions of how well leaders in the company manage and deal with them. The sentiments varied depending on the department and shift, which directly reflected individual differences in the leadership styles of particular supervisors and managers. Being patient or losing one’s temper, being polite or screaming at people, being understanding or blaming people for mistakes, considering psychological factors that affect people or not - these were the dimensions of leaders’ people skills mentioned by people. It seemed natural that workers were appreciative when they perceived that their leaders demonstrated good people skills, and were not if they perceived their leader to have poor people skills.

REPORTING

There are two major categories of incidents that had to be reported. The first one includes injuries and accidents with bodily damage of an employee and the second one includes hazards and near misses. Reporting is an important part of the organisational learning process, i.e. continuously improving safety based on lessons learned from mistakes made in order to avoid them in future. Reporting was also recognised in the subject literature as an important factor, being a part of safety culture (Fung, Tam, Tung, & Man, 2005).

Both shop-floor workers and leaders (supervisors and managers) openly indicated that reporting (in different forms), whether formal or informal, was an area of concern, as it did not happen as often as it is supposed to, as a result of which the data gathered did not adequately reflect the situation on the shop floor. It needs to be emphasised that all employees are required to report accidents and failure to comply with that obligation may result in serious consequences including a disciplinary measure or dismissal. Workers were very clear on the reasons behind their reluctance to report problems or incidents. With regard to reporting injuries that could be hidden from the sight of management, the most frequently cited reason was the amount of paperwork involved. These citations created a theme, discussed below.

REPORTING - Paperwork

According to the interviewed employees, one of the reasons behind the reluctance to report injuries and accidents was the amount of paperwork involved. The same forms needed to be filled in, regardless of whether the incident was a serious accident or a minor finger cut. Filling out this form might take from one to three hours and required a worker, his supervisors, and in some cases witnesses or a member of the Health and Safety team. After the paperwork was done, a formal investigation was conducted by the members of the Health and Safety team and departmental leaders (supervisors or managers). The conclusions from the investigation were reported to the corporation. Also, the corporation supervised the implementation of counter-measures to avoid having a similar incident in the future. In general a high priority was placed on removing direct causes of accidents. Even though changing the paperwork requirement for minor cuts and bruises seems to be an easy solution, it was the company headquarters in the U.S.A. that was responsible for setting and changing policies. In a conversation between the researcher and one of the corporate managers responsible for safety it was indicated that the corporation was interested in gathering as much information about both accidents and minor incidents as possible and they were not willing to change the policy. It was not surprising that workers were reluctant to go through that procedure if the injury or problem they wanted to report was not of very high priority.

Another group of incidents referred to reporting, non-injury incidents, which were hazards with the potential to harm somebody or a free injury event in which somebody was almost injured but luckily avoided bodily damage. This type of incident was encountered more often, in relation to the size of the plant and the amount of hazards involved in the production processes, movement of people and mobile equipment etc. However, the priority for the removal of these hazards and direct causes of near miss incidents was not as high. The reported elements were not reported on a regular basis to the corporation and were managed locally. As dealing with this type of incident was more frequent the employees' comments on the process were more varied. This type of incident might be reported in a number of ways: verbally or with help of special, short forms, handed out to every employee in a form of small book called Injury Free Event (IFE) books (see Chapter 5). An employee either had to tell his supervisor about a problem or used the form and hand it to his supervisor. Despite this opportunity, employees reported the low effectiveness of this process and their low motivations to be engaged in reporting.

REPORTING - Solutions were not provided or were provided with significant delay

This waiting period, often with no information about the progress of the reported case, breed frustration and anger especially if the problem referred to elements that were necessary to do the job properly. It sometimes led to situations in which a worker was on the one hand expected to do his job safely according to the company's expectations, and on the other hand, was not provided with the tools necessary to be safe (see also: "breaking safety rules" theme).

Another negative consequence of these long waiting periods was expressed in the line employees' perceptions that leaders (supervisors and managers) did not care about the reported issues. Employees attributed the causes of those problems to the departmental leaders - supervisors and managers. If the reported problems were not addressed in a timely fashion, the first reaction of workers was to say that leaders did not react and nothing got done. Other issues described referred to the situations in which leaders forgot about reported problems or did not even engage, due to the paperwork involved. The interviewees also mentioned the effects it has on them. Cynicism and a decreased engagement and motivation to raise any problems were among the consequences discussed.

Problem solving in such a large multi-departmental organisation often depended on more than one person. For example, to repair a tool or a machine, a worker must have first reported a problem to his or her supervisor. The supervisor then had to open a ticket on a computer and sent it to the maintenance department. In the maintenance department this ticket was put in a queue and a level of priority was assigned to the ticket. As maintenance has limited resources, the highest priority was given to the problems directly affecting the production process, such as a furnace in the foundry – (if it did not work the parts could not be cast). Hence in the case high-priority problems, solving issues of lower-priority was usually postponed indefinitely. To make the situation even worse, there was no formal communication system with which to inform ticket-raisers about when to expect the repair or solution. If the problem was important to a given departmental manager, he could informally direct the maintenance manager to assign more resources to this particular problem and solve it. As this arisen in a number of departments at the same time, it provoked an interpersonal conflict between managers.

BREAKING SAFETY RULES

Breaking safety rules – the next theme – refers not only to shop-floor employees, but also to supervisors and managers. Employees agreed that sometimes they or their colleagues break safety rules. However, as the fact of breaking safety rules probably happens everywhere to some extent, the most important questions refer to the reasons behind this behaviour.

BREAKING SAFETY RULES - Experienced employees and leaders broke safety rules

A number of examples were provided in which more experienced workers broke rules. As old-timers were usually partially responsible for on-the-job training, by breaking the rules they did not serve as a good example and taught new-comers bad habits and set this undesired behaviour as an informal norm. Similarly with leaders (supervisors and managers), as they were seen breaking safety rules, workers did not feel compelled to behave differently.

BREAKING SAFETY RULES - Leaders turned a blind eye

Some employees also reported that leaders sometimes turned a blind eye, unless the job was particularly dangerous. Usually it happened in a situation of high production pressure, but not exclusively. Some examples included breaking rules for the sake of convenience or avoiding additional effort in finding alternative ways of doing particular jobs. Often these initiatives were led by leaders or were tacitly approved.

BREAKING SAFETY RULES - Equipment was not properly designed

Another issue provided by interviewees was related to inappropriately designed equipment that could not be used for certain jobs or was difficult or uncomfortable to use it. This aspect of the working environment was difficult to overcome by junior leadership and usually requires the engagement of senior management to order machinery replacement or provide repairs, which are frequently costly.

PRODUCTION PRESSURE

Production pressure refers to the employees' perception that pressure does exist and affects their work. As the company in question operated in the manufacturing sector, it earned profits from the large quantities of parts it produced. On the one hand, many managers were aware of detrimental effects of putting much pressure on employees and they officially, verbally communicated that they give employees time so they did not have to hurry. Although line employees confirmed that they were not being told to work faster, they emphasised that in their experience this pressure was exerted in indirect ways. It was not about performing their basic tasks faster, but rather controlling what the operatives did in the mean time and if a person was seen waiting or standing between production cycles waiting for a part to process, they were told to start sweeping the floor or engage in another substitute activity. As a result, this pressure to work all the time and never rest was transmitted to the operatives, even without explicit verbal directions to that effect.

JOB SECURITY

The company had a policy, which was regularly communicated to all employees, stating it was continually looking for savings and competitive advantage over its competitors. Some employees interpreted this information as suggesting that in a hard economic climate when labour prices go up the factory may be moved to another country where the operating costs are lower. This fear was expressed by both managers and workers. It become very real after redundancies were applied in 2009.

4.8.6. Summary

Six themes were identified as affecting safety from the point of view of the employees: communication, leaders' people skills, reporting, rule breaking, production pressure and job security. All of these themes had already been discussed in the literature. The study allowed a preliminary understanding of the complex nature of the close relationships between these factors.

Although based on limited evidence, due to both the restricted sample size and the limited scope for an in-depth probing of the responses, taken as a whole the above findings appear to suggest that the themes identified at the company are not very different from the accounts of other companies in regard to headline variables with potential to affect shop-floor safety culture. The identified themes have been highlighted in the findings reported by a number of quantitative studies (Glendon & Litherland, 2001; Mearns, Flin, et al., 2001; Mearns, et al., 2003; Taylor & Thomas III, 2003; Thompson, et al., 1998; Zohar, 2000). The strength of the grounded qualitative approach adopted in this study is argued to be that it has been possible to derive key insights not just of what is important, but also of how. Further, in what ways these problems occur and of the implications relating to their consequences. This type of insight is unavailable in quantitative studies and at the same time, crucial for developing safety culture interventions.

4.9. Discussion

This study aimed to familiarise the researcher with the environment of the company and identify areas related to safety that employees find important and problematic in the sense that they can affect their safety. A further purpose was to inform the development of a question set for group discussions in order to investigate the factors affecting the company's safety culture systematically and in depth.

Familiarisation with the safety documentation helped understanding that the company is very strict in its compliance with Health and Safety regulations. A very skilful, knowledgeable and experienced team was making sure that all new regulations accepted by the British Parliament will find appropriate compliance in the policies and procedures on the site. The extensive documentation stated in fairly deep detail what was allowed and what was not. Furthermore, the impression of the researcher was that the company was emphasising the importance of compliance with the rules (at the level of management and shop-floor) with no much room for open dialogue with operatives. They were just expected to comply with set rules or face disciplinary measures. The understanding was that this approach will help to protect the health of the employees, but it was based on an assumption that they are neither able nor willing to care about their safety, and that in the case of injury they would try to manipulate a situation and seek the compensation. Although it was certainly the case that some individuals were caught lying about the details of an accident's causes in an effort to obtain money from the insurer and the company consequently sought to protect itself from fraud, the researcher's impression based on numerous conversations was that an assumption was made that *all* employees behave that way, and that they therefore had to be rigidly controlled with extensive, written and formal regulations. Possibly this approach served well in court but on the other hand it may have impersonalised the contact between safety department management and shop-floor employees. Parts of the process of complying with legal regulations of the HSE were countless improvements of the work environment. However, the company also introduced a number of initiatives that were not derived directly from legal obligations but served a more general aim of hazard identification. It was attempted to engage shop-floor employees to spot hazards and report them to the management. The same goal was pursued by many means (interventions), such as putting yellow labels on broken machinery (red flag program) or providing extra time for chosen individuals to look for hazards. To date (mid- 2010) only the IFE program was being continued. All other interventions, as far as the researcher was informed, died out along with declining motivation of intervention participants. Also, the only evaluation of the effectiveness of these programs was the ratio of solved to unsolved problems. No other relation to injuries, accidents or workers' perceptions was established. This may suggest that either employed staff had no appropriate knowledge and skill to develop an evaluation, or that it was the corporation that imposed the majority of safety actions.

This impersonalised and compliance-focused approach was to some extent reflected in the past surveys of the company. The most negatively assessed elements were related to the respect towards shop-floor employees, managerial efficiency and involvement in decision making. Later, in the "Global Voices" survey, similar elements earned negative scores. All these elements together offer a consistent picture of leadership and safety climate in the company. Individual interviews helped deepen the understanding of the subtleties related to leadership and safety. Specifically, the interviews linked many of the employees' safety concerns with the various skills and attitudes of the company's leadership. Not communicating effectively, inconsistent behaviours, turning a blind eye and a pervasive focus on paperwork all affect employees' motivation to respond to safety initiatives positively.

4.10. Critical findings

1. The process of familiarisation with the company consisted of four stages, which included a review of the relevant documentation, observations, participation in meetings and interviews.
2. Safety interventions from the past were initiated by either the corporate or local management and focused mainly on engaging employees to detect hazards and raise maintenance tickets.
3. In 2003 and 2004 the company undertook "People Skills" survey that indicated that employees negatively assess management effectiveness, the amount of respect they receive from the managers and the extent to which they feel involved in decision making. However, they strongly identified themselves with the peer group and felt accountable for their jobs.
4. Since 2006 the company has been administering the "Global Voices" survey in all its locations worldwide. In 2009 employees most negatively assessed the following dimensions: leadership / vision, working conditions, recognition and employees' engagement. The most positively rated were: safety and quality, but only safety surpassed the threshold of 50%.
5. The analysis of individual interviews with employees revealed six themes discussed by the workers: communication, leaders' people skills, reporting, breaking safety rules, production pressure and job security. All had already been covered in the subject literature.

Chapter 5

Qualitative assessment of safety culture

5.1. Introduction

Conclusions drawn on the basis of evidence from the preliminary investigation into employee risk taking (Chapter 4) identified a range of factors affecting safe style of working. These factors appeared indicative of the likely importance of a range of cultural and situational variables as dispositional influences on volitional risk-taking behaviour.

However, questions might be asked regarding the generalisability of these findings to some broader basis for risk-taking behaviour in a range of different production departments and functional positions at the company, given that: a) the preliminary study was conducted on the shop floor during working hours and so the time available for interviewing employees was limited and conversations tended to be disrupted by production tasks and related noise, b) the conversations were not structured, c) the exploration of operatives' understandings of risk and the basis for their motivations towards risk behaviour were restricted due to the lack opportunity for verbatim recording of their responses. Furthermore, it was felt that a more structured approach was required in order to provide insights allowing the development of a questionnaire to test the generalisability of findings.

In an attempt to gain further insight into shop-floor workers understanding of risk, and the reasons they provide for volitional risk-taking, it was considered that a more detailed investigation into these variables was called for. Given that the research was principally exploratory in nature, combined with the researcher's limited knowledge about safety culture for this particular site, it was considered that, at least in the first instance, a fundamentally organic, qualitative approach was needed. This decision was reinforced by the insights gained from freely associative approach adopted during the preliminary study, the utility of this of approach within risk research, and other areas of social science activity having been highlighted by a number of authors, from a range of disciplines (Bailey & Hutter, 2008; Barbour, 2007). Although qualitative investigatory approaches, of various types, are commonly encountered in social and cultural research, and this is the case for the growing contribution to risk research from these disciplines, it is perhaps notable that a number of the more recent studies of safety culture have also begun to adopt such approaches, at least during the early exploratory stages of their investigations (e.g. Gillen, et al., 2004; Olsen, Bjerkan, & Nevestad, 2009) where the use of loosely structured, freely associative elicitation techniques forms an integral part of the method, typically, serving to inform subsequent aggregate, questionnaire-based, approaches to studies of public perceptions of risk.

A potential advantage of adopting a qualitative approach at this stage within the present research was, considered to be that the richness of the data which this was likely to yield, when compared with more reductionist techniques. It was felt that a qualitative approach would provide benefits with regard to the researcher's understanding of the complexities of the shop-floor work environment; the social relationships which permeate it and most importantly the context in which risk taking takes place.

5.1.1. Aim

The purpose of the study was to identify strengths and weaknesses related to safety in different departments and influences on how risk is perceived and reacted to by employees.

5.1.2. Objectives

1. To develop insights to underpin the development of a staff survey which when administered across the company's divisions would allow for quantitative assessment of departmental safety culture profiles.
2. To develop an understanding of strengths and weaknesses related to safety that employees face on regular basis, to inform the development of bespoke safety culture change / improvement interventions to be developed.

5.2. Method

5.2.1. Design

There is a spirited debate over the relative merits of individual or group interviews and their capacity for eliciting data from participants. Advocates of the former (e.g. Fischhoff, Bostrom, Jacobs, & Quadrel, 1997; Lynn, 1999) argue that group dynamics may suppress the expression of opinions of those individuals who do not feel confident or for any other reason may be inhibited from expressing their views in social settings. Others take a view that the group context may actually facilitate and stimulate disclosures that otherwise remain unarticulated (Frith, 2000). Potential inhibition of intimate details is actually the only strong argument against group discussions. There are more arguments supporting the application of focus groups, rather than individual interviews in organizational settings: a) they can provide a way of a quick gathering data from a large number of participants (Wilkinson, 2004), b) the dynamic of discussion is more akin to a naturalistic conversation and may extend to storytelling, joking, arguing, teasing and disagreement (Jarrett, 1993) which may also evoke vernacular responses (Bers, 1987), c) also, the group interaction allows respondents to react to and build upon the responses of other group members creating a “synergistic effect” (Stewart & Shamdasani, 1990). This may lead to more elaborated insights about researched phenomenon. This effect is supported with emotional involvement of participant which is seldom seen in one-to-one interviews (Gillham, 2005). In short, there is strong evidence that group elicitation techniques offer a number of advantages over individual interviews (Gillham, 2005).

In summary, focus groups are widely regarded as an effective tool for exploratory purposes that can relatively quickly and easily provide an early indication of the range of views, attitudes and experiences of participants on a given subject.

5.2.2. Sample

Negotiating access

The access to staff was negotiated with members of the senior management team, and they agreed to publicise the opportunity for employees to participate in the study. Relevant representatives of the trades union were informed about the planned study and their approval and support were obtained. It was agreed with senior management that they would allow employees to leave their workplace for 60-90 minutes to participate in group discussions.

Sample frame

Group interviews could not be carried out on the shop-floor due to the lack of an appropriate location, i.e. not enough space, permanent noise, many distractions and the presence of supervisors and managers. Therefore, an office area was chosen with discrete conference rooms. It was a concern that the presence of a supervisor at the meeting with the shop-floor workers could suppress their spontaneous expressions. Additionally, if supervisors were present confidentiality could not be maintained and so only peers from particular groups were invited.

A pilot discussion, followed by eight focus groups was conducted during May and June 2008. Table 6 gives a breakdown of participants by department and job-role that took part in the study. The group discussions were department-specific, i.e. in each discussion involved employees from a single department.

Table 6. *Date and number of participants in focus group discussions from particular departments*

Department/ group	Date	Number of participants	Number of employees in departments (2008)
Small Wax – pilot group	7.05.2008	3	103
Large Wax	14.05.2008	12	117
Foundry	22.05.2008	8	78
Large pre-finishing	06.06.2008	8	52
Alloy Plant	23.05.2008	10	84
Ceramic Core	28.05.2008	7	62
Maintenance	30.05.2008	5	56
Supervisors	17.06.2008	5	28
Managers	26.06.2008	3	22
TOTAL NUMBER OF PARTICIPANTS:		61	602 plus 419 employees from other departments = 1021

The number of people in each group was dependent on the number of volunteers who were able to secure release from their normal duties. It was agreed with the senior managers that the priority would be to focus on the largest departments employing the highest number of people. It was argued that by interviewing employees from the largest departments this would develop insight about safety issues concerning the majority of the workforce, as it was assumed that the nature of problems would be shared by the majority of employees within particular departments. The number of all employees working within the eight largest divisions comprised nearly 50% of all workforce of the company (approximately 500 individuals).

Table 6 shows that the total number of focus group interviewees constituted 6% of the total population of employees. As the focus groups participants were invited from the largest departments, it may be argued that the views held by the interviewees represented the views of the majority. No information about age or tenure was collected. The Human Resources department strongly suggested that the researcher should not gather demographic information about the participants of the focus groups, expressing concerns that the personal data could not be protected as expected by law (Data Protection Act 1998). The participants invited to take part in the focus groups came from the largest departments, in the hope that they would represent the majority of the workforce. No stratified sampling was employed to represent all departments. The groups consisted only of employees working at the same level in the organisational hierarchy in the same department, meaning that managers, supervisors and shop-floor employees were interviewed separately, and that shop-floor employees from different departments were also interviewed separately. The aim of the sampling was to get a spread of perspectives from a range of the largest departments and different job types in order to avoid systematic bias. As the names of individuals interviewed on the shop floor (see Chapter 4) were not recorded, it cannot be confirmed whether the same individuals were interviewed individually and in the group setting.

Selection of a moderator

Having developed a discussion protocol that would probe safety related topics, it was necessary to identify the most appropriate manner in which to conduct the focus group sessions. As Barbour (2007) opines there is no one best way to lead a focus group and an appropriate strategy should match both, the purpose of the research and characteristics of the group.

Litosseliti (2003) suggests that a good group moderator should understand the topic of the discussion and have been in contact with the researched community before. In the interest of consistency the same person should also ideally lead all of the groups in a given set. In the current instance, the researcher was experienced in conducting focus groups and had derived a high degree of familiarity with organisational, as well as socio-technical and physical aspects of the work environment. Therefore, the author was considered well placed to moderate the discussions.

5.2.3. Materials

In order to conduct the focus groups it was necessary to develop a set of questions that, on the one hand would stimulate discussion and further elaboration of topics identified in the preliminary study, while at the same time, encouraging debate so as not to impose constraints that would limit discourse to these issues.

In order to identify a set of topics that could be discussed with the company's employees a range of information sources were drawn upon:

1. Research findings based on unstructured individual interviews conducted with employees of the company (see Chapter 4),
2. Mainstream literature on safety culture (see Chapter 2),
3. Consultations with experts - were not recorded verbatim, but aimed to inspire the researcher to explore aspects of safety culture that were not vividly presented by the subject literature. This approach can be potentially criticised however the context of the consultations must be understood. The researcher had a desk next to three other members of the Health and Safety team and was also talking to other managers on regular basis. The researcher was also in often contact with the academic supervisors. This meant that over a period of the first six months of the project, the researcher spent hours on informal conversations with experts and managers about a wide range of topics. Many of the discussed topics were related to the research and the researcher explored experts' understanding of the matter, comparing their knowledge with the research findings, discussing and sometimes arguing on a variety of topics. This reflected the informal interactions in order to develop an understanding of a complicated subject (employee behaviour in an organisational setting). It was not possible to record every single conversation verbatim, and potentially it would not be possible to analyse that amount of text effectively. Furthermore, the conversations were not one-off events, but happened many times

over the course of every working day. It may be argued that this approach to data collection was unsystematic, and that could potentially be a true statement within a positivist paradigm (see Chapter 3). However, it may be argued, within the constructivist paradigm, that knowledge and meaning are developed by a researcher as the result of his interactions with the world around him, and it evolves with time and new information gathered. Therefore many conversations with the experts and managers had this character of not transferring knowledge from an expert to a learner, but rather of exploring different ways of understanding very complex phenomena. Many of the comments of the team members indeed inspired the researcher and challenged his thinking and helped to develop his understanding. This benefited the research process, as the researcher could ask more informed and relevant questions. The consulted groups included:

   a. Academics researching safety cultures (N=3) highlighted the importance of exploring what ‘management engagement’ means and how it is expressed / displayed in the real world,
   b. H&S specialists from H&S department in the company (N=3) highlighted issues of personal accountability of employees, violations of rules and risk taking.

4. Consultations with the company’s executive managers,
5. Findings from staff surveys conducted in the company in 2003-2007 (*People Skills Survey* and *Global Voices Survey*) (see Chapter 4).

These sources were supplemented by insights derived from the researcher’s embedded experience of staff discourses on safety and broader workplaces topics, socio-technical elements and working conditions. As it was decided to conduct focus groups with employees from different departments and functions across the company, the questions were appropriately phrased. For example: to investigate perceptions of leadership, shop-floor workers were asked about their supervisors, but supervisors were asked about their managers. A copy of the question set is provided in Appendix C.

5.2.4. Pilot discussion session

In the first instance a pilot focus group was conducted. This procedure permitted testing of a number of practicalities related to conducting subsequent sessions:

1. How to invite people to minimise the probability of refusal.
2. Assessment of the appropriateness of the question set.
3. Opportunity for the researcher to increase familiarity with the protocol.
4. Opportunity to obtain feedback from participants on the researcher's performance as a moderator.

Questions were well received and initiated interesting discussion engaging all participants. Also the moderator and his style of leading the discussion appeared to be well received. The pilot session allowed an opportunity to hone logistic and procedures for conducting the focus groups. Also, it demonstrated that there was no need to find an external moderator.

5.2.5. Procedure

In order to obtain analysable data at an appropriate level of detail verbatim transcripts of group discussions were needed from the focus groups. This required audio recordings to be made of proceedings. British Psychological Society guidelines were followed with respect to the engagement with participating employees (BPS, 2004).

After the each group, the audio files were transcribed verbatim. Following this the audio files were ciphered, secured with password and stored at a back-up hard-drive.

5.3. Data analysis

5.3.1. Selection of method of data analysis

As Morgan (1993) states the analytical techniques adopted should be suitable to the intended aims of the research, logically and robustly derived. Thematic analysis fits the aims and objectives indicated at the beginning of this chapter to the highest extent comparing with other methods for qualitative analysis. Narrative Analysis and Interpretative Phenomenological Analysis were not used as the outcome of these methods is very descriptive and did not suit the need of developing a questionnaire.

The aim of this study also was not developing a theory, therefore Grounded Theory approach was not chosen. Content Analysis requires a set of pre-assumed themes/concepts that are later tested by means of word count. This also did not fit the goal of the research. Thematic Analysis allows for data reduction and the development of smaller number of underlying constructs, based upon theoretical linkages supplemented by evidence of apparent association between themes grounded in the transcript data itself. The process of analysis, in general terms has three main stages: (a) initial coding, (b) grouping interrelated codes in higher order categories, and (c) grouping interrelated categories in even higher order themes.

5.3.2. Initial coding of transcripts

Codes identify a feature of the data that appears interesting to the analyst and refer to the small excerpts of text that can be assessed in a meaningful way with regard to the analysing phenomenon (Boyatzis, 1998). The process of coding is a part of the analysis (Miles & Huberman, 1994) as it allows organising data into meaningful groups. Coffey & Atkinson (1996) emphasize there is no right or wrong way of coding. Coding and theme searching is the process of disassembling and reassembling the data (Ezzy, 2002). Braun and Clarke (2006) suggest working systematically through the entire data set, giving equal attention to every bit of data.

In this analysis every transcript was converted into a table to divide the text into smaller segments of information according to the individual utterances of particular participants. Also, the researcher’s contemporaneous notes were added where relevant in order to help with the analysis in later stages. The coding stage was conducted on a computer using a text processor. Each transcript (N=8) was coded in full. The coding process resulted in the development of 108 initial codes, where every code was a word or a short sentence describing the content of particular pieces of text. The full list of codes may be found at Appendix C.

5.3.3. Identification of initial categories

Braun & Clarke (2006), suggest that similar / intuitively associated codes should be collated together creating categories / groups of initial, interrelated codes. As the text extracts and codes were already in a table, each code could be separately copied and pasted into another file creating a new table. This process allowed the creation of new groupings that contained citations related to a common code/topic.

For example, codes like: “Supervision”, “Supervisory practices”, “Supervision – actions undertaken” and similar were identified in all transcripts. Next, every piece of text with an attached code related to supervision was copied separately to another file creating a table containing only pieces of text linked to a variety of aspects of supervision and supervisors.

The operation was performed for each initial code. Unique codes that did not possess transparent linkages with others were put into miscellaneous category. This process resulted in 37 initial categories. The table below shows how codes were categorized and how the groups were titled.

Table 7. *A list of initial codes composing initial categories*

Names of categories	Initial codes collated according to the topic they cover
1. ACCIDENT INVESTIGATION	➢ Accident investigation (AI) ➢ Investigation
2. BLAME	➢ Blame
3. BLIND EYE	➢ Blind eye
4. CLAIMS	➢ Claims
5. COMMUNICATION	➢ Communication ➢ Communication – using posters
6. CONTRACTORS	➢ Contractors
7. CONTRADICTORY MESSAGES	➢ Contradicting messages ➢ Contradictory messages
8. CORPORATE	➢ Corporate
9. CUTTING CORNERS	➢ Cutting corners
10. FEEDBACK	➢ No feedback ➢ Need for feedback ➢ Lack of feedback ➢ Feedback – newsletter ➢ Feedback – need for Feedback
11. HEALTH EFFECTS	➢ Health effects (HE)
12. HOUSEKEEPING	➢ Housekeeping
13. IFE	➢ IFE
14. IMPROVISATION	➢ Improvisation
15. LACK OF REACTION	➢ Lack of reaction ➢ Lack of reaction - consequences ➢ Lack of reaction – postponed solution - Consequences of lack of reaction ➢ Passivity, ➢ Postponed reaction ➢ Not effective resolving
16. LACK OF RESOURCES	➢ Lack of equipment, ➢ Lack of resources ➢ Lack of resources – lifting gear ➢ Lack of resources – man power ➢ Old equipment, Maintenance
17. MANAGERS	➢ Differences in priority – managerial decisions ➢ Leadership, ➢ Managerial skills

	➢ Managers - LMX ➢ Managers – no personal relation ➢ Managers – people skills ➢ Managers - skills managers ➢ Managers, ➢ Safety leadership,
18. MOTIVATION TO WORK	➢ Co-workers ➢ External motivation ➢ Money ➢ Motivation to work ➢ Motivation to work – co-workers, ➢ Motivation to work - job itself ➢ Motivation to work - money, ➢ Motivation to work - pride ➢ Motivation to work – variety of tasks ➢ Preferred shift pattern
19. OLD CULTURE	➢ Old culture ➢ Used to be better
20. ORGANIZATION	➢ Poor organization ➢ Organizational learning ➢ Organization of department
21. PAPERWORK	➢ Paperwork
22. PHYSICAL CONDITIONS	➢ Physical conditions (pc) ➢ Pc – lack of room ➢ Pc - lightning ➢ Physical conditions (PC) – lack of spare space
23. POSITIVE PERCEPTION OF COMPANY’S APPROACH TO SAFETY	➢ Positive perception of company’s approach to safety
24. PPE	➢ PPE
25. PRESSURE,	➢ Pressure – from workmates ➢ Pressure, ➢ Production pressure ➢ Time pressure,
26. REACTIVE APPROACH	➢ Reactive approach
27. RECOGNITION	➢ Recognition, ➢ Recognition – advantages
28. REPORTING OF ACCIDENTS	➢ Reporting claims ➢ Reporting hazards ➢ Reporting, ➢ Underreporting, ➢ Minor injuries
29. ROLE OF H&S	➢ H&s ➢ H&s role ➢ H&S team ➢ Role of H&S
30. RULES BREAKING	➢ Breaking rules ➢ Rules breaking
31. SECONDARY RISKS	➢ Secondary risks
32. SHIFT LEADER	➢ Shift leader - role ➢ shift leaders – limited power
33. SUPERVISION	➢ Supervision ➢ Supervision - lack of in nightshifts ➢ Supervision – actions undertaken ➢ Supervision – difficult to find them ➢ Supervision - fairness ➢ Supervision - inconsistency ➢ Supervision – lack of and consequences ➢ Supervision - not enough

	➢ Supervision – not on the shop floor ➢ Supervision – support for safety ➢ Supervisory practices
34. TRAINING	➢ Training – safety on job limited ➢ Training,
35. TURNOVER	➢ Turnover,
36. UNDERTAKEN RISKS	➢ Undertaken risks
37. MISCELLANEOUS	➢ Emotions ➢ Group consistency ➢ Personal time

The collation of text excerpts ascribed a common code allowed for a re-focusing of the analysis aimed at the identification and naming of higher order codes, or themes (see next section). All text excerpts coded in a similar way were iteratively re-appraised and reviewed to consider how these similar codes may combine to form overarching categories. This process also helped in formulation of sub-themes (facets within each global theme).

5.3.4. Identification of themes

Following the recommendations advanced by Braun & Clarke (2006) relating to *reviewing categories* stage of the analysis and Patton's (1990) regarding internal homogeneity, the process of reviewing and revising categories was taken to a further level. All the collated extracts within each category were read and reviewed and considered whether they appear to form a coherent pattern (theme). At the end of that process it was concluded that there was insufficient data to create themes from the following categories and so these were removed from the analysis:

1. CLAIMS
2. CONTRACTORS
3. HOUSEKEEPING
4. MISCELLANEOUS
5. MOTIVATION TO WORK
6. PHYSICAL CONDITIONS
7. POSITIVE PERCEPTION OF COMPANY'S APPROACH TO SAFETY
8. PPE
9. ROLE OF H&S
10. TURNOVER

The remaining 27 categories either were left unchanged or a number of categories were merged together (on the basis of conceptual relatedness) creating new themes. The table below shows which categories were turned into themes and which ones were merged together to create more general theme.

Table 8. *A list of categories composing higher level themes*

	THEMES	CATEGORIES
1.	COMMUNICATION	Communication Contradictory messages Feedback Lack of reaction Lack of resources Improvisation
2.	CORPORATE IDENTITY	Corporate Old culture
3.	LEADERSHIP	Managers Organization Shift leader Supervision Blame Blind eye Recognition
4.	PRESSURE	Pressure
5.	REACTIVE APPROACH	Reactive approach Accident investigation
6.	REPORTING	Paperwork Reporting of accidents Ife
7.	RULES BREAKING	Cutting corners Rules breaking Secondary risks Undertaken risks
8.	TRAINING	Training

5.3.5. Defining themes and identifying sub-themes

As Braun & Clarke (2006) suggest, the final stage of analysis should be focused on deriving definitions for the emergent themes and identifying the constituent sub-themes. In order to accomplish that analysis all text excerpts that belonged to each theme were reviewed one more time to identify the "essence" of what each was about. The names of themes and their definitions are shown in Table 9 below.

Table 9. *Definitions of themes*

	THEMES	DEFINITION
1.	COMMUNICATION	Relates to all elements that affect the efficient flow of information between different levels of the organisational hierarchy.
2.	CORPORATE IDENTITY	Relates to all these aspects where employees of the

		company feel affected by the decisions and actions undertaken by representatives of the corporation owning the site.
3.	LEADERSHIP	Relates to skills of managers, management style and the character of interactions between workers and managers.
4.	PRESSURE	Relates to the perceived causes and effects of felt different types of pressure.
5.	REACTIVE APPROACH	Relates to the situations where hazards are removed rather after accidents than before.
6.	REPORTING	Relates to systems supporting processes of reporting accidents and near-misses and reasons for underreporting.
7.	RULES BREAKING	Relates to reasons of cutting corners and aware acting against safety rules.
8.	TRAINING	Relates to the consequences of not providing sufficient training for new comers and other employees.

5.4. Discussion and interpretation of the identified themes

5.4.1. Communication - feedback

The issues relating to communication are widely cited in the safety culture literature (Berends, 1996; Cox & Cheyne, 2000; Diaz-Cabrera, Hernandez-Fernaud, & Isla-Diaz, 2007; Fernandes-Muniz, Montes-Peon, & Vazquez-Ordas, 2007; Fung, et al., 2005; Glendon & Litherland, 2001; Mearns, et al., 2003; Mohamed, 2003; Silva, et al., 2004).

At the company, on the one hand, employees felt encouraged, by a variety of communication means, to report safety problems; on the other hand, they reported routinely not knowing what happened to the information they submitted: no feedback was given. An effort to provide extra information about risks and hazards to the management may be considered as involvement and there is a significant body of evidence, in empirical studies by Locke and Schweiger (1979) and Katzell and Guzzo (1983) suggesting that employee involvement increases job satisfaction and productivity (Fenton-O'Creevy, 1998). The core of interviewees' complaints referred to the perception that the majority of the problems reported were not addressed, leading to a perception that employee concerns are not valued:

> *"When we bring a safety issue up, what is the main reason that it is not done? Maybe you can ask that question and then come back to us."* [shop-floor employee 5, Ceramic Core]

“I have had issues where I have tried to pull out Health and Safety to management and nothing still has been done about it. And that is after two years.” [shop-floor employee 4, Large Wax]

For employees the fact that Health and Safety expectations are formally communicated but not followed through becomes a contradictory message and affects their attitudes:

“If you see all these problems going on, day after day, after day, and you get preached from higher levels they want to solve it, and nothing gets done about it, it must affect you mentally as well.” [shop-floor employee 6, Large Wax]

Such a perception may exist for two reasons: either the resolution was not offered or no feedback was provided that it had been addressed. Delays in resolution can also be corrosive, in so far as they can transmit the implicit message that the issue is not a priority, and / or that it is not recognised as important by the organisation:

“Eventually it’s done, but it takes too long” [shop-floor employee 9, Alloy Plant].

“Leaking pipes get patched up but don’t actually get repaired” [shop-floor employee 2, Large Wax]

“They said you have to have new guns, because there is a vibration problem, it took them two years and you had new guns, exactly the same, different named ones, but a little bit of rubber stuck in there and that was it” [shop-floor employee 7, Alloy Plant].

“It is not classed as a priority; they don’t class it as a priority. But it is a priority because you are damaging your eyes” [shop-floor employee 12, Large Wax],

“Do they care about our safety? Not much, don’t they? Oh yeah they do, they don’t want us to get hurt, but they don’t see that as a big issue compared to some other things” [shop-floor employee 3, pre-finishing].

Perceived lack of communication following their initiative causes disaffection:

“Cause they don’t see anything being done, he reports something, six weeks later it still has not being fixed, you can look at it and what is the point” [shop-floor employee 11, Large Wax].

“You have heard my cell leader saying to me: ‘Well, I will tell the manager’ but I don’t think it will make any difference” [shop-floor employee 2, Ceramic Core],

creates passivity:

"So actually making a stand does not make any difference" [shop-floor employee 5, Large Wax],

decreases motivation:

"Well, makes you not report didn't it? Cause it might be suited for 12 months anyway" [shop-floor employee 2, Foundry],

and creates disengagement:

"If you moaned once and then you have to moan again and again and again surely you just get bored with it" [shop-floor employee 1, Pre-finishing].

Edmondson (1996) has commented that when employees perceive that their concerns are not valued or addressed this tends to foster a negative climate that inhibits the willingness of both managers and employees to communicate freely and discuss mistakes and issues. The central role of communication in safety climate was demonstrated by Mohamed (2003), who found that effective organisational communication is related to a more positive safety climate. Limited feedback may have a range of negative implications for safety on the shop-floor: it can create disaffection and passivity in the group of shop-floor employees and may be a source of indifference of employees to formal communications, and this effect may hinder their motivation to participate in future safety improvements.

5.4.2. Corporate Identity

The company was bought by a multinational corporation in 2000. Therefore, "the old" culture of the company, policies, management structure, style of working, company values etc. were subjected to the challenge of harmonisation with the corporate perspective:

"There is definite difference. There are, I would suggest, a number of people on site that are from the old school of the company and they know a different way of working and we have noticed the significant change with the corporation" [Manager 1].

This theme is very context-specific and probably time-sensitive; in ten years' time it may be diffused to a large degree. However, this theme is important, as it affects the work identity and job security of employees who have worked here for a number of years:

"It feels like now that we are a part of a much larger entity and we are just a little square in a ledger and at some point somebody may put a cross in that ledger" [Manager 3].

The new owner of the company is being perceived as an entity that is extremely focused on numbers and measuring different aspects of performance:

"Corporate have this couple of people or team of people constantly trying to reinvent something, a new way of measuring something" [Manager 2].

On the one hand, the focus on measures positively affected safety:

"I think some of the things we have introduced, painful that they were, things like lock out tag out, full prevention, and I actually think those have been good things, painful to install but I think they are good things because educating people on this is the right thing to do." [Manager 1].

On the other hand, measures are used to control managerial performance and, in the opinion of the managers, are used in a confrontational manner to pinpoint individuals not performing to the corporate expectations:

"The measures are so damning on you" [Manager 3].

In addition to its outcome-based safety performance measures, the corporation, following the takeover, in its drive for continuous improvement, introduced a range of new programs and initiatives related to safety and other aspects of organisational performance (2004 – 2010, see Chapter 3). The parent organisation imposed its systems across all businesses in the group – and attempted to impose common safety systems and solutions – irrespective of the history of each site. Reports were encountered that this process caused people and resource overload:

"You tend to know what are the number of resources available, which is not endless and the number of initiatives which are on the go. No person or no team of people can actually review the results from all of those initiatives" [Manager 2].

There was also evidence of initiative fatigue– in instances where new initiatives are reportedly introduced without cancelling the previous ones. A number of managers portrayed a situation in which they felt under regular assault, being bombarded by new initiatives and interventions emanating from the parent organisation. In some instances, the sentiments expressed suggest that these "foreign" tools and techniques were of limited local relevance or value:

"When you got all this chatter [about new programs] going on as well, I think it dilutes the effect of what is really important" [Manager 1].

What makes it even more difficult to manage is the perception that:

"The corporation is very mechanical now, not personal" [Manager 3].

The corporate approach to managing the site was widely characterised by senior managers as impersonal and focused on management by outcomes, with a number of potentially negative implications for safety, such as overloading available local resources (people, money, goods) with new initiatives and reducing the performance of older programs. That could be because the corporation is a large network of people who are responsible for different elements of performance to different extents. It is very difficult to build rapport with corporate representatives as in most cases they expect performance indicators that can be obtained with internal or external audits. While there may arguably be consistency gains from a homogenous corporate approach to managing workplace risks, this has to be balanced against the potential to decrease intrinsic engagement and ownership of risk management systems amongst local managers. In that instance there seemed to be a clash of cultures. The "solutions" imposed by the parent organisation did not seem to fit with the local culture as employees saw little value in them and were not motivated to participate. The shared perception was that managers are overloaded and are not able to address all expectations, partly because the corporation diverted resources from local safety issues.

The theme "Corporate Identity" or similar was not found in the safety literature. However, the "clash of cultures" resulting from mergers and acquisitions is already known to researchers (Ashkanasy, 1995; Badrtalei & Bates, 2007; Baughn & Finzel, 2009) and advice is available on how to manage resources and people during organisational takeover (Pike, 2006). Although some evidence has been generated on the cultural difficulties of merging companies, no research was found analysing the impact of mergers on safety culture and safety performance. Therefore, it is argued that the "Corporate identity" aspect is a novel finding in the safety culture arena and requires further exploration.

5.4.3. Leadership

Reference to dimensions relating to the central role played by senior management leadership may be found in almost all studies of workplace safety culture: maintenance and management issues (Coyle, Sleeman, & Adams, 1995); management overall concern (Janssens, Brett, & Smith, 1995); managerial safety climate (Prussia, et al., 2003); management safety practices (Hayes, Perander, Smecko, & Trask, 1998); Management commitment (Hahn & Murphy, 2007); management support for safety (Thompson, et al., 1998); line management commitment (Fung, et al., 2005); managers' attitudes and behaviours (Fernandez-Muniz, Montes-Peon, & Vazquez-Ordas, 2007); managerial safety climate (Brown, et al., 2000); perceived supervisor competence (Mearns, et al., 2003); supervisory actions and expectations (Zohar, 2000); supervisor safety (Hayes, et al., 1998); supervisor support for safety (Thompson, et al., 1998); supervisory environment (Mohamed, 2003); supervisor support (Seo, et al., 2004); supervisor's role (Fung, et al., 2005); supervisory safety climate (Brown, et al., 2000); supervisor safety (Lu & Shang, 2005); supervisor trust and safety (Taylor & Thomas III, 2003); leadership style (Diaz-Cabrera, et al., 2007). The leadership dimension is widely acknowledged as one of the most important and influential factors affecting safety culture. In the current study, leadership is taken to refer to the orientations and behaviour of shift leaders, supervisors and managers[8].

LEADERSHIP - AVAILABILITY

Shop-floor workers often reported encountering problems related to safety or production that needed supervisory attention, but portrayed a situation in which supervisors and line managers were rarely seen on the shop-floor and / or had limited time to devote to resolving shop-floor issues:

"*If have an issue you can phone the supervisor or you can better see him, but not everybody can see him. Sometimes he has to go away and a room has been left to somebody else, so that person may have something else to do, so you are always kind of chasing the issues. It's not their fault, but you have to come out of your cell,[9] which defuses the whole object of doing your work*" [shop-floor employee 3, Large Wax].

"I think they have got a lot to deal with. They got more and more shared problems. I think they are overloaded" [shop-floor employee 8, Large Wax].

"I don't really see a lot of them, they don't get involved, they seem to be locked in an office and don't really involve themselves with the operators I would say" [shop-floor employee 4, Pre-finishing].

[8] The terms are explained in the glossary section.

[9] A cell is composed by 3-5 people whose work is synchronised and if one person has to leave the cell it stops all other people working in that cell.

They come down, but only really just passing through, cannot really involve with day-to-day running" [shop-floor employee 8, Pre-finishing].

and would appreciate if managers were more available on the shop-floor:

"It would be nice to see him on the shop floor a little bit more" [shop-floor employee 1, Foundry].

The availability of supervisors and managers translates to the availability of resources to solve safety- and production-related problems, as these leadership positions hold decisional power to assign assets in order to resolve these problems.

LEADERSHIP – PEOPLE SKILLS

The operatives mentioned the importance of managers' empathy towards them:

"It gets so hot, you are sweating so badly, it makes your eyes sting, if you take your glasses off to clean it and he catches you with glasses off, he even gets a supervisor to tell you off or he does it himself. It's not like: 'Oh, the fans are not working' but you know: 'Put your glasses on!'" [shop-floor employee 4, Foundry].

This attitude of managers towards workers is noticed even in routines as basic as greetings:

"But managers would come and then look at a board where are productivity figures, and it is literally from here to about here (less than one meter) and they didn't say good morning to two people who were virtually facing them. It is an awful thing to do, I think" [shop-floor employee 12, Large Wax].

"*I spoke to him I reckon nine times, said hello, nothing, and he spoke to me once and I was in the toilet and I thought maybe that is the way [with him]"* [shop-floor employee 2, Pre-finishing].

The quoted situations indicate a limited degree of rapport and free exchange between supervisor / managers and staff. The implication for safety relate to barriers to the free exchange of information. However, such situations also have an emotional impact and may be a source of intimidation or low self-esteem:

"Some people are approachable, some people treat you like a person, you speak to them like man to man, when others, they look down on you and I suppose you feel a little bit intimidated by them because they own that power" [shop-floor employee 6, Foundry].

"They won't speak to you. They just keep walking so we are nothing to them, we're just a number and that's it" [shop-floor employee 6, Pre-finishing].

This sub-theme complements the previous one. Leaders not only have to be available, but they also need to demonstrate a positive attitude towards their subordinates as this positive character of the relationship affects the motivation of employees to reciprocate in a way desired by leaders (Lee, 2004). As was demonstrated in Chapter 2, the relationship between leaders and subordinates is an important element of organisational efficiency and shop-floor employees expressed a desire to be able to remain in regular contact with their superiors. There is some evidence suggesting that the quality of these relationships, based on the rules of reciprocity, affect compliance with safety and engagement within safety matters (Hofmann, Morgeson, & Gerras, 2003).

LEADERSHIP - INCONSISTENCY

Leading by example and the consistent enforcement of safety rules across all departments and employees is widely cited as an important part of shaping operatives attitudes and behaviours (Hale, Heijer, & Koornneeff, 2003; Komai & Grossman, 2009; Lawton, 1998). The focus group participants shared their perception that leaders sometimes turned a blind eye for the sake of production and improving output figures:

"I think that probably a lot of people are aware of that but they turn a blind eye, because the production figures improve because of it" [shop-floor employee 5, Foundry].

One of the reasons for citing for this was that production pressure results in the prioritisation of some actions over others, leading to the suggestion that managers and supervisors sometimes turn a blind eye to operatives' unsafe behaviours and breaking rules where this allows production objectives to be met:

"Very heavy moulds being put on high shelves and on low shelves. They try to blind-eye when they need to" [shop-floor employee 3, Large Wax].

"But when it suits managers, they just go underneath [where it is prohibited], oh yeah, but rules are rules, but it doesn't bother them" [shop-floor employee 7, Ceramic Core].

Another example (below) of inconsistent supervisory behaviour with regard to safety rules enforcement showed that the operatives were encouraged to undertake unsafe actions despite prior communication of the risks associated with that task:

"I refused to move moulds before, because they are on right and you can't put them on that place, because ergonomically you shouldn't be lifting them. But instead

of that being, the supervisor just gets somebody else to do it, so somebody else comes along and does it" [shop-floor employee 8, Large Wax].

Moreover, misgivings were expressed over the extent of compliance, and managerial commitment to compliance, again suggesting inconsistent supervisory behaviour towards the social legitimacy of putting safety first:

"They say Health and Safety is up there in the fore-front, but in reality it is not, to be honest. You can just go to my department, walk about, cooling was not working, doors leaking, cranes are not checked, it is endless really" [shop-floor employee 1, Foundry].

The implementation of Health and Safety policies refers not only to the removal of physical hazards, but also to demanding compliance from people:

"They are saying not wearing your PPE is disciplinary, you can walk around the room any time of the day and you will find someone not wearing, glasses on the head, or not wearing the jacket" [shop-floor employee 1, Large Wax].

Although it is the job of departmental supervisors to ensure that all shop-floor employees comply with procedures, it seems to be difficult for them as they are afraid of how management may react to their putting safety before production:

"I think sometimes it is very difficult to a supervisor to actually tell your boss that somebody is not gonna do something because you don't want them to do it because you don't think it is safe" [Supervisor 3].

"I have done it more than once and it put you at loggerheads with the persons in charge. I have certainly had a request for a certain job to be done and I said, hang on a minute, no he is not going to do that because it is not safe. And then you put yourself right in the firing line." [Supervisor 4].

Another group of topics refer to the perceived extent to which supervisors treat people equally in regard to rule enforcement:

"Doesn't seem to be fair rules right across the board for everybody, even if it comes to PPE and safety things, some people, the majority of us wear it but there are certain individuals that never wear the overalls. Always have their glasses on the head, and they never get disciplined and it is just unfair" [shop-floor employee 11, Large Wax].

or deciding about privileges:

"Some people are allowed to have shift changes and some people aren't, some people are allowed to do what they like, breaks and things like that and some people aren't." [shop-floor employee 6, Ceramic Core].

Based on the above examples it may be argued that employees perceive an inconsistent message about safety from senior managers. Although there are rules and procedures, it seems that in some cases they may be seen as getting in the way of speedy production and so an expectation not to comply is being communicated indirectly.

A number of shop-floor employees opined that sometimes there is silent approval not to comply strictly with safety rules and that may be promoted by both managers and supervisors. The inconsistency between formal expectations and their inconsistent enforcement may result in the development of the attitude: "we can do whatever we want until we are caught".

As the supervisors and managers are figures within the organisation who potentially model the behaviours of their subordinates (Komai & Grossman, 2009), any inconsistencies on their account in that respect can directly affect shop-floor employees (Simons, 2002). Operatives seeing their leaders breaking safety rules or agreeing to the rules being broken under their supervision may on the one hand provide permission for them to default to the quickest and easiest path, which routinely embodies greater risk, and on the other hand, may create cynicism towards policies and procedures and its enforcement attempts, hampering the effective development of new safety improvements. The interviewed employees indicated that they wished leaders to be available, demonstrate a positive, personal approach towards them and to display behaviours consistent with the current policies and procedures.

5.4.4. Pressure

Pressure is a widely recognised factor affecting safety behaviour (Brown, et al., 2000; Glendon & Litherland, 2001; Mearns, Flin, et al., 2001; Mohamed, 2003) and safety culture. In general terms, pressure in the manufacturing sector is created by the need to produce a requisite output within a finite time frame. Respondent accounts highlighted an array of contexts in which time pressure conflicted with safety considerations. According to the operatives, there are two main sources of pressure:

leaders and the work environment. Leaders' expectations and priorities can play a role:

"We all have an expectation that they know whether they have met a fair expectation so I don't think we say you haven't done enough, they know that 50 is your expectation." [Manager 3].

"You have got the quality people are interested in quality only, they don't care how many you produce until they are good, and then you put the other side of the coin, just bloody get out the monoshell [one of departments], *get them done, so you are trying to keep both happy"* [Supervisor 4].

the control of work and verbal urging:

*"We have a mister ***, wandering around asking why production is slightly lower today than it was yesterday."* [shop-floor employee 2, Ceramic Core].

"They always ask you how long. How much longer you gonna be? You can't really say because you can get on the machine, you can bump into a problem that you didn't expect." [Maintenance employee 5].

"If you don't do a certain amount, then they will say: hang on a minute, how come you did this yesterday but you only did this today" [shop-floor employee 10, Alloy Plant].

or close personal supervision:

"Especially if you are trying to do a job, you are doing in a safe way and everything and you have got four supervisors from that department stood there watching you wondering why and what are you doing, so you have got pressure of them watching you." [Maintenance employee 2].

However, attributing pressure solely to leaders would limit the understanding of its causes, as the interviewees indicated that elements of the work environment impose time and production pressure on workers as well. For example a lack of human resources puts more responsibility on individuals:

"[Without enough men in the department] You gotta be a bit quicker and it makes the job more risky" [shop-floor employee 8, Foundry].

"I have got such a large number of people with basically rubbish skills, those [experienced] people are carrying the department, the ones that are skilled, and I think they really feel under pressure." [Manager 2].

"Now there is imbalance between experienced and inexperienced people in there which puts a lot more pressure on the experienced ones because as well as

getting on and getting the numbers out and everything else." [shop-floor employee 4, Foundry].

Moreover, time limits may be imposed by machines time cycles and breakdowns:

"Once they got it in, then the pressure transfers to me, because I have got a certain length of time when I'm gonna cast it" [shop-floor employee 3, Foundry].

"When it's a breakdown of the machine that they are using for production at that time that means, I think, when you see when the pressure is there, in the background, 'cause they will be saying: well how long is it going to take, what is it?" [Maintenance employee 1].

Pressure may diminish workers' attention and cause misjudgements:

"'Cause you're struggling to get the work done in the time, and because you are struggling to get the work done, you are not paying as much attention to everything going on around you which means accidents are more likely to happen." [shop-floor employee 10, Large Wax].

"When you're under pressure you make misjudgements." [shop-floor employee 5, Large Wax]

cause the violation of safety rules:

"I experienced driving a fork truck with faulty brakes. Now I should have locked it out and tagged it out, but that would involve shutting the unit down and there is pressure not to shut that unit down. Production pressure." [shop-floor employee 2, Foundry],

limit time and resources to provide proper training to inexperienced people, as in the majority of cases on-job training is provided by more experienced colleagues from the same department:

"Because it is such a high volume of work that we have got, you are not really given the time to come off your work station and actually look after these people properly. It's a case to give a quick induction and then keep going back and checking on them but you are obviously expected to keep doing your work at the same time as checking somebody else." [shop-floor employee 6, Ceramic Core],

limit the regular maintenance of machinery:

"We have got to have the machinery, of course if you havn't got the machinery then production aren't producing anything so this sort of push-pull sort of attitude between equipment and I think that maintenance need to understand that production

make the money and they need to keep it going, but production also needs to realise if they don't stop at some stage to have the machines looked after, they will eventually stop working and this balance between maintenance and production in this company seems to be very sort of fraught with difficulties." [Maintenance employee 4].

Production pressure is perceived by employees as having two main sources: leadership approach and the effectiveness of technical systems and resources. Interviewees held beliefs regarding the negative consequences of pressure on them and their work environment. Being under pressure may diminish the attention of individuals, making them more prone to mistakes, breaking or bending safety rules and spending less time on training new-comers, in the case of experienced operatives (Gaba, Howard, & Jump, 1994; Mearns, Flin, et al., 2001) or limiting the scope of the maintenance of machinery. In short, the consequences of high pressure are negative and may be a source of risk.

5.4.5. Reactive Approach

The reactive approach refers to employees' perception that the company removes hazards after accidents take place rather than trying to prevent accidents. Fleming & Lardner (2002a) clearly divide the methods used to identify at-risk behaviours into proactive and reactive, where the latter is much poorer than the former.

Marais, Saleh, & Leveson (2006) demonstrated that the reactive focus of many safety improvement programs results in the primary emphasis being placed on investigating previous incidents and accidents in an attempt to prevent future accidents. These efforts are not always fruitful. It has been suggested that excessive focus tends to be placed on preventing the recurrence of exactly the same accident, without taking sufficient account of the underlying systemic precursors and their generalisability to other hazards. Symptomatic solutions to accidents often only reduce the likelihood of that particular accident recurring; they do not eliminate the deeper structural deficiencies that led to the accident in the first place.

An appreciation of this insight led Reason (1997) to typify his Reactive Approach to safety as a characterisation of organisational culture, this also being a feature of the safety culture maturity model (Lawrie, Parker, & Hudson, 2006). In each case a reactive approach is cast as an insufficient focus on prevention.

Participants often expressed the perception that the company was reactive to accidents but did not proactively seek and manage hazards:

"If someone is injured in the event, generally something is done about it. But if someone is not injured in the event, then it is questionable to getting it sorted." [shop-floor employee 3, Large Wax]

"They wait for an accident to happen before they actually do anything about it." [shop-floor employee 6, Large Wax]

"Because they get bitten up by the people above them if they don't do it right, when somebody does hurt themselves it is like, oh my god we have got to be seen to be doing everything we can and everything else actually needs to be dealt with goes by." [shop-floor employee 2, Large Wax]

"No, they must be sitting around waiting for this opportunity, but they are not around in advance sorting this out." [shop-floor employee 11, Large Wax]

"There is a lot of focus when there is an accident, but prior to an accident there doesn't seem be that much attention." [shop-floor employee 3, Large Wax]

"But at the end of the day, instead of being Health and Safety, it's more wealth and safety, because if it is cheap for them to fix it, they will fix it straight away, or if it is going to be very costly for them in a core case, somebody gets hurt by it, then they fix it." [shop-floor employee 5, Ceramic Core]

All of these voices clearly lay claim to there being more visible attention to hazards after an accident than before. This attention and turmoil is indicated by additional people coming to the departments:

"But you see a Health and Safety officer when something like that happens [implied – but not at other times]" [shop-floor employee 6, Pre-finishing]

"When there is an accident, you will see six yellow waistcoats there in an hour" [shop-floor employee 1, Large Wax]

An examination of past practice reveals that the parent corporation tends to take a number of definite actions after a serious accident in any of its plants in the world. There is a strong expectation that every major accident or serious incident be investigated and reviewed at the corporate level. At the same time limited effort is being put into learning from non-injury occurrences and regular and careful observation of the work environment, possibly resulting in missing some potential causes of future accidents. As such, this theme is directly related to issues linked with reporting, which will be discussed in the next section.

5.4.6. Reporting

Reporting accidents, injuries and near-miss incidents is a potentially very important element of organisational learning (Edmondson, 1996). It allows the identification of casual influences, typically embedded in some combination of the physical environment, technical and socio-technical systems. Therefore, the under-reporting of accidents and near-misses is a serious problem for any organisation. There may be a number of reasons for which under-reporting may take place and this was explored with respondents. The literature reports that under-reporting may be related to the perception of risk regarding occupational hazards as those who felt most "safe" reported fewer accidents and near-misses (Mearns, Flin, et al., 2001). Other studies show that reporting accidents is correlated with organisational commitment and communication (Fung, et al., 2005).

These are important findings, but they are generic. The qualitative data collected here allowed for a more in-depth and contextualised understanding of people's motivations to withhold information about accidents and near-misses.

REPORTING - ACCIDENTS

There are many events that could be used to learn about hazards in the workplace. One of them is investigating the root causes of accidents. However, to be able to do that, employees first have to be willing to report them. While fatal and major accident data can be considered substantially accurate, complete and reliable (Attwood, et al., 2006), it is apparent that minor-injury and medical-room entry data are prone to a range of amplification effects (Cooter & Luckin, 1997). Focus group participants provided a number of reasons motivating the non-reporting of these of minor injuries / medical room entries.

The disincentives cited included the degree of bureaucracy and form filling associated with the procedure.

"You have to write a report, and then somebody comes and talks to you about it, then you have to go through another forms-filling session and if all you have done is burn your arm on the hotplate it's just not worth it. Because they then say, what we can do about it, well, I need to remember not to put my arm on the hotplate." [shop-floor employee 10, Large Wax]

"The first thing you done you have got the paper work out, and if he (supervisors) is unsure about anything he phones down to Health and Safety and gets them to come up and help with the forms" [shop-floor employee 4, Foundry]

"I think as because the system is so time-consuming as well and amount of paperwork they have to fill in then half of us probably don't even want to put the supervisor through that" [shop-floor employee 7, Foundry]

Another inhibitory effect cited by the respondents was the fear of being blamed in case it was subsequently determined that the injury was the result of an employee's mistake, rule infringement or volitional risk taking.

"Sometimes it might have been your fault potentially, maybe you done something stupid" [shop-floor employee 8, Foundry]

"One guy was disciplined for doing the wrong thing. He put himself at risk by putting his hand on the open die, come down anyway, he wasn't badly hurt but he was disciplined. A problem in there with this part of disciplining somebody who has reported an accident, so what do you think that guy is going to do next time with his finger. Is he gonna report it?" [Supervisor 3]

REPORTING – NEAR-MISSES / INCIDENTS

At the company there is also a system that aims to gather information about safety incidents and near-misses. It is called IFE (Injury Free Event) and has a format of small books of A7 size, given to all employees, where every page may be used as a "ticket" to report problems or report unsafe behaviours of work colleagues. These "tickets" are given to supervisors who have a responsibility to enter the information from the ticket into a database. This database is reviewed by a department manager who has the decisional power to assign adequate resources to solve the issue. Participants shared a number of reasons for their resistance to this method of reporting.

One of them is the lack of feedback about implemented solutions after the delivery of an IFE. It seems to be consistent with the communication theme suggesting that lack of feedback is detrimental for employee motivation and engagement.

"I put an IFE in last week in my area, as my shift leader did and see how quickly it happens cause I put two or three job tickets for the same thing over the last 12 months and have not been resolved." [shop-floor employee 4, Pre-finishing].

"When you look at the amount of dust that is flying around up there, that is the IFE every day, you breathing it in." [shop-floor employee 6, Pre-finishing].

According to the operatives' perception, it is easier and quicker to resolve small problems without reporting them. Putting additional time and effort into taking a book, filling out a ticket and handing it to a supervisor was seen as too laborious and counterproductive, especially if it was supplemented by the feeling that it may not be resolved or it may take a long time before a solution will be provided.

"If you see something like that just not look and write but sort it out by yourself, what you can do, sort it out, you don't have to keep writing everything down and then send them off, this is not right" [shop-floor employee 1, Pre-finishing].

"There was sweep and brush up fallen on the floor and they put a ticket, sweep and brush presents a trip hazard. Well, in the time it took them to write up that ticket they could have lifted it up and hung it on its place" [Maintenance employee 1].

Additionally, as the IFE form allows the reporting of a colleague' unsafe behaviour it was felt that behaviour observation may be factor acting against a team and as such having a potentially detrimental effect on relationships among group members:

*"I don't want to write in my little book oh B*** wasn't wearing her earplugs, oh here you are, and make myself look good and make everybody else think, hheeeyyy, you wrote that out, why didn't you just tell [her] she wasn't wearing it, why didn't you tell her she was overloaded in the impreg tank. Why did you have to write it down in a book? Me personally that is how I feel about it, and that's why my book is in the locker, and I don't say nothing."* [shop-floor employee 3, Ceramic Core].

The findings described above provide an in-depth understanding of people's motivations that is, impossible to catch with a quantitative approach. This understanding is crucial for a successful attempt at subsequent behavioural change. The main effect of underreporting on safety is that it limits the amount of insight available to the company about risks and hazards present on the shop floor, as well as potential causes of accidents and injuries. Furthermore, it skews the accident data-base, which may lead to inappropriate actions being taken or may contribute to a slowdown of the development of new safety interventions.

5.4.7. Rules Breaking

The importance of having good, practicable and workable safety rules has been emphasised by a number of studies investigating the safety culture topic and accident investigation. Lawton (1998, p. 94), who published a paper on the reasons for rule breaking, states:

"It is important to remember that violations occur because rules exist. Rules are one means by which an organization attempts to influence or control the behaviour of its employees. However, there are disadvantages to using rules as a means of organizational control, in particular, that rules require time, effort and resources to enforce. Furthermore, working to rules requires less understanding of the functioning of the system, making it opaque. This can cause blindness to new situations that do not immediately fit the rules. Rules also require restriction of behaviour, which may be perceived to reduce the skill required to do the job successfully. This loss of freedom can cause resentment, particularly when people feel that they are being watched all the time."

Flin, Mearns, Fleming, & Gordon (1996) provided evidence that attitudes towards safety rules predicted accident involvement, and it was supported by Mohamed (2003), who demonstrated that perception of safety rules influences the safety climate of a company, thus suggesting that attitude towards safety rules is an important factor shaping safety climate and possibly affecting injury rate.

In the group of interviewees it appeared to be obvious for some individuals that breaking safety rules happens on the shop floor, so the discussion was more about the reasons for breaking rules. The most frequently recurring comments related to the perception of safety rules as inadequate or wrongly designed and limited in flexibility:

"We wear helmet and there is no need for us in bullet cell, cause we haven't got overhead cranes flying around as such over there". [shop-floor employee 5, Alloy Plant].

"Some of the rules were made years ago, and there are better ways to do things and if somebody finds the better way to do it but maybe breaking the rule they may still do it, in their eyes it's easier to do it that way". [shop-floor employee 2, Pre-finishing].

"And now they brought in a silly rule where you can't use the top two steps of a ladder, the top step I understand, but the next two stepping steps you can't use to

work anywhere. But they won't let you have any taller ladders". [Maintenance employee 5].

However, employees also understand the importance of rules and their protective function and, if they notice rule-breaking behaviour, they can prompt their co-workers to comply:

"Where are your gloves?' we prompt each other, but that one thing I can say about that, the older ones that have been here longer time they tend to keep reminding, sometimes I had to be reminded about my earplugs or be reminded about my glasses". [shop-floor employee 6, Ceramic Core].

The utterances of participants suggest that if these rules are not being continuously adapted to the needs of particular divisions based on the insights of the shop-floor employees, it may lead to the rules not being followed, or to the creation of informal ones. It is worth emphasising that in such a complex, multi-departmental organisation there is a huge variety of production processes and thus rules to protect the health of employees. Therefore attitudes towards safety rules should be investigated, keeping in mind that these contextual insights are findings that apply to one department but may not be relevant to others. Based on that premise, it is argued that the approach to safety rules will be different in different departments, affecting safety to different extents.

5.4.8. Training

Employers in the UK are legally obliged to provide H&S training to their employees under "the Health and Safety at Work etc Act 1974" and "Management of Health and Safety at Work Regulations 1999". The importance of training has been underlined many times by safety-related research. According to Graham, Ramirez, Finlay, Hoy, & Richards (1996), training determines work performance and efficiency and affects safety behavioural performance (Reber & Wallin, 1984). Fernandes-Muniz et al. (2007) state that a company has a positive safety culture if it has safety management system and one of the crucial elements of that system is training and the quality of its delivery. Lack of adequate training is one of the latent variables leading to unsafe acts or human failures. Diaz-Cabrera et al. (2007) demonstrated that training is a part of safety culture and refers to the perception of employees of the type of training organised by an employer. These results are consistent with the findings of Lawrie et al., (2006), who provided evidence that training is an element of a company's safety culture. The perception of having a lot of safety training correlates with high scores in the safety climate scale (Lu & Shang, 2005), and trained people feel safer in their environment, as they know how to deal with hazards. Smith, Cohen, Cohen, and Cleveland (1978) reported that increased safety staff, safety committees and safety training were associated with low accident rates in companies. The importance of training is well demonstrated in the literature, but the literature cannot provide contextualised information about specific problems with training in the company or about the perceived consequences of not having a very good training system.

During the focus groups, participants shared some of their concerns related to training. As the variety of jobs in the company is considerable, every single position involves a different set of safety-related risks and hazards. Knowing them is important to avoid injuries, but it requires the provision of context-specific information to new-comers. According to the respondents there was no job-specific training in place (except mandatory and generic introductory Health and Safety training) and no person designated to provide on-job safety training within departments:

"The only bit of safety advice I had when I went into the foundry was: 'assume everything is hot and don't touch it', literally. And I had to rely then on the kindness of the lads who were actually working there to actually show me what to do. They did not have to if they did not want to" [shop-floor employee 1, Foundry].

"Basically you learn off the cuff, as you go along, basically, you self-teach yourselves" [shop-floor employee 7, Foundry].

"When I first came in, I spent two and a half days walking around, that is what I did, walk around, nobody showed me anything" [shop-floor employee 8, Foundry].

As a result, new-comers are not fully aware of the risks associated with their jobs. One of the causes of this situation is the fact that there is no designated person to run job-specific training. It is assumed that current employees will teach a newcomer what is necessary.

That may be attributed to work design and the efficiency of managing resources by the management. However, it seems that in the company it is assumed that training will be provided by the experienced old-timers but they cannot do that due to the production pressure that they experience. The consequences of the limited scope of training strongly affect safety, as new-comers are not only exposed to hazards with which they are not familiar, but they also do not know the procedures of how to behave in case of emergency, and their understanding of safety rules is limited.

5.5. Discussion

The process of learning about the company's safety culture(s) involved focus-group discussions (N=8 groups) with the representatives from the largest departments and leadership groups (N=61 respondents). There were differences in the nature of work of supervisors, managers and shop-floor workers. The focus groups discussions reflected these differences. The participants talked about things most important to them, so managers talked about different aspects of work than supervisors and supervisors about different aspects of work than shop-floor employees. The main challenges for managers related to balancing corporate expectations, dealing with corporate managers and constantly high expectations. The supervisors focused on the difficulties of controlling the demands of production, interdepartmental communication and managing resources. The shop-floor employees talked about all other aspects identified in the analysis. It was felt that the particular groups were complementary, so it was decided to analyse them together. Thematic analysis resulted in the description of eight construct themes considered relevant to the characterisation of safety culture. The aim of the focus groups was to gather insight into staff perceptions with regard to safety and risk taking that could be quantified in the next stage of research in order to obtain information about the distribution of particular elements across departments. That information would inform decisions on the type of intervention and target groups by job role and function.

The analysis of focus group discussions permitted the creation of eight themes affecting safety in different ways: communication, corporate identity, leadership, pressure, reactive approach, reporting, rules breaking and training. Each theme represents an aspect of organisational performance that has an impact on employees and their attitudes and behaviour. The results of the analysis of the focus group discussion closely resembled the results of the individual interviews analysis. Five themes were common to both analyses: 1. Leadership, 2. Reporting, 3. Breaking rules, 4. Pressure and 5. Communication. The theme identified by the analysis of individual interviews but absent in focus groups discussion was 'job security'. The analysis of the focus group discussions produced two themes that did not appear in the results of the individual interviews: 1. Corporate identity and 2. Training. Almost all of the themes have already been recognised in the subject literature, except the “corporate identity” theme. It is unique to the situation in which the company found itself after being acquired by a multinational corporation of American origin, where after the merger two different cultures and working styles had to be merged and employees felt and are still feeling the difference between the new and the old company.

However, what seems to be an important insight emerging from the analysis is the fact that the identified factors do not function independently and their separation makes sense only for clarification purposes. In fact, the elements of organisational performance described by every theme are mutually dependent and interconnected affecting each other. It is important to understand these connections to understand a complex system of variables affecting employees’ perceptions of safety.

Communication and - in the context of the company - the perceived lack of feedback to the reported safety problems creates disengagement and limit the amount of information provided to the management about risks and hazards, and this affects reporting, as passive employees are less likely to use IFE books to report near-misses. As a result, the company has less information about hazards. However, there is one more consequence. The corporation sets an expectation of how many IFEs should be raised per employee per month. Not realising the goal may put some pressure on the management and, depending on their people skills (leadership theme), they may pressure shop-floor employees to produce more IFEs. It may have a detrimental effect on safety perceptions, as in such a case the IFE scheme becomes a tick-box exercise and not a meaningful tool allowing learning from the operatives’ experience. This target-based approach to the IFE scheme is a result of the corporate policy towards reporting injuries and near misses imposed on all plants worldwide (Corporate Identity theme). Additionally, it affects motivation to report injuries and accidents (Reporting - Accidents theme) as the amount of paperwork involved in that process is discouraging for many employees including operatives and supervisors. Despite admitting that some safety improvement schemes introduced by the corporation improved safety on the site and increased safety awareness, managers indicated that the approach to them and to these changes is in their eyes impersonal, does not recognise available resources and focuses strongly on paperwork limiting their time to interact with employees (Communication - Feedback theme and Leadership – Availability theme). Moreover, at the time of the interviews, it seemed that the corporation placed more emphasis on investigating accidents than on their prevention, supervising managers more closely on the results of investigations, which was expressed in the operatives' observations of how the company reacts to incidents compared to preventive actions (Reactive Approach theme). Another element of leadership, except availability, is inconsistency. Leaders, by leading by example, create norms and model behaviours, so turning a blind eye to employees' risk taking or displaying other inconsistencies in relation to safety may justify to some extent, in the minds of operatives, breaking rules and cutting corners (Rules breaking theme). Furthermore, it may be argued that managers / supervisors display these inconsistencies as the result of straining under production pressure (Pressure theme) which is partially created by the corporation (Corporate Identity theme). With regard to production pressure, not only are managers susceptible to it, but they also become a source of pressure for shop-floor employees (Pressure theme) along with other sources of pressure in the work environment, like machine cycle times or staff shortage. The perception of production pressure is another factor driving the breaking of safety rules (Breaking Rules theme) among operatives. It also limits the time that experienced workers devote to training new-comers in the risks associated with particular jobs (Training theme). Limited training results in a lower awareness of safety rules, becoming a third factor contributing to the breaking of rules by employees. Additionally, not knowing what is allowed may limit confidence that a certain action did not break safety rules and increase the frequency with which safety incidents are reported (Reporting theme), just in case somebody interpreted it as rule breaking, which could lead to the disciplinary route. Incomplete training is also linked to limited knowledge about risks and hazards, so it increases the probability of injuries and accidents.

The foregoing discussion sought to demonstrate that all the identified elements are actually interconnected and interdependent. Changing one of them affects many others. It is also unrealistic to think that any of the themes is a discrete entity that affects safety independently of other elements. This insight, which is a result of the researcher's observations and informal conversations, as well as of formal research activities, suggests that investigating any of the themes in isolation limits our understanding of the organisation as a dynamic system.

5.6. Critical findings

1. Conducting this study created a base for the development of the safety culture questionnaire described in the next chapter.
2. The analysis identified eight factors related to safety at the company. These are: 1. Communication, 2. Corporate Identity, 3. Leadership, 4. Pressure, 5. Reactive approach, 6. Reporting, 7. Rules breaking, 8. Training.
3. The majority of these factors have already been identified in the subject literature, except for Corporate Identity, which is very specific to the situation in which the company finds itself and affects safety to a significant extent.
4. The themes create a network of interdependent variables affecting and influencing each other with the result that safety is affected by a combination of factors and not separate variables.

Chapter 6

Quantitative assessment of safety culture

6.1. Introduction

A core aim of this thesis was to develop and implement safety culture interventions in order to improve the safety performance of the company. Although the insights from the focus groups were very informative, these were limited with regard to the generalisability of the conclusions. The qualitative data did not allow the creation of departmental safety culture profiles, which are essential for the development of safety improvement programs. Moreover, there is evidence in the literature that white-collar staff may perceive safety significantly differently to blue collar staff, and those divisions may have different cultures, so-called sub-cultures (Clarke, 1999b; Weyman & Clarke, 2003). The difference in perceptions of safety among different groups of employees may have a strong impact on the design and application of improvement interventions, so testing was called for. Additionally, a tool was required to benchmark and monitor the change in employee safety perceptions. Based on these premises, it was decided that the development of a safety culture questionnaire was an important stage in the development of an understanding of the company's culture(s) and that this would complement existing insights into employees' perspectives on safety culture. The resulting safety culture questions were embedded into the company's annual staff survey and conducted in 2008. A principal component analysis was performed on data gathered in 2008 to establish the component structure for the safety culture questions.

6.1.1. Aim

To identify a finite set of underlying constructs that can be considered to characterise the core variables affecting the safety culture at the site.

6.1.2. Objectives

- To generate a survey to address the above aim, to be completed by a sample of the company's employees.
- To explore the psychometric properties of defining influences on workplace safety culture.
- Further to explore the range of components underlying employee orientations on risk-taking behaviour.
- To provide a degree of triangulation with the previously gathered qualitative evidence (Chapters 4 - 5).
- To develop a set of reliable sub-scales that can be used to benchmark the profile of variables affecting on safety culture at the site and test for demographic differences across the organisation.

6.2. Questionnaire development

The questionnaire items were designed to reflect the themes and sub-themes identified in the qualitative studies (Chapters 4 - 5) and were informed by theoretical insights gathered from the review of the literature (Chapter 2). The list of items for the questionnaire was strongly informed by the qualitative data, including the discussions with supervisors and managers, as well as with the shop-floor employees. There were also items sourced from the literature. Therefore it is argued that the range of statements was appropriate to assess different job groups. The Table 10 shows what items constituted particular dimensions.

Table 10. *Relationship between the results of the individual interviews, focus groups, safety culture questionnaire items numbers and subject literature*

Individual interviews (Chapter 4)	Focus groups (Chapter 5)	Questionnaire items numbers[10]	Literature
	Reactive approach	5,7,22,30	(Fleming & Lardner, 2002a; Marais, et al., 2006)
Leader's people skills	Leadership (management & supervision)	2,4,6,9,11,14,19,20,25,27,28	(Diaz-Cabrera, et al., 2007; Fung, et al., 2005; Hahn & Murphy, 2007)
Reporting	Reporting	3,18,24,29	(Edmondson, 1996; Mearns, Flin, et al., 2001)
Breaking rules	Breaking rules	13,23	(Flin, et al., 1996; Lawton, 1998)
Pressure	Pressure	10,12	(Glendon & Litherland, 2001; Mohamed, 2003)

[10] The reasons for not translating all themes into survey items and reasons for unequal representation of the themes in the questionnaire are provided on pages 123-125.

Communication	Communication	17,21,26	(Cox & Cheyne, 2000; Silva, et al., 2004)
	Training	15	(Fernandez-Muniz, et al., 2007; Graham, et al., 1996)
Job security	Corporate identity		
		Recognition - 8	(Brun & Dugas, 2008; Hansen, Smith, & Hansen Ries, 2002)
		Accident investigation - 16	(Basnyat, Chozos, & Palanque, 2006; Kletz, 2006)

As a first step in the development process the constructs that emerged from the thematic analysis (see Chapters 4 - 5) were used as the basis for developing clusters of related items. Where possible use was made of verbatim quotes and adaptations of quotes as the basis of the constituent questions. This was used to create an initial battery of 250 items.

A constraint on the number of questions that could be included in the survey related to the level of access that could be negotiated with the host organisation, as the only available option for data collection was to embed the concepts of interest as a component of the annual staff attitude survey. Embedding the safety climate items in this way brought advantages in terms of coverage and response rate, but had the drawback of placing a constraint on the number of items that could be included.

Through consultation with senior managers, agreement was reached over the number of safety culture questions that could be included. This was set at a maximum of 30 questions. That decision was dictated by practicalities and financial considerations. It needs to be emphasised that taking about 1000 people off work for 15-30 minutes (whether completing the survey on-line or via hard copy) was a substantial cost for the business to bear. Moreover, understandably the senior management team wanted to maintain a degree of influence over what questions would be asked of their employees. In the view of the researcher, presenting himself as a student helped to build rapport and trust, and this influenced the richness of the qualitative data. However, there was also a downside to this. It meant not having authority to influence decisions. An example of such difficulties was clearly observed during the process of deciding the final set of questions for the safety culture questionnaire. The senior managers had an interest in what questions were asked, as this could potentially inform their decision making, and they expressed some suggestions of what questions they would prefer to be included in the questionnaire. But the suggestions were not made in order to avoid getting answers on a particular subject, but rather to get the answers to the questions important to the managers, and so the final set of questions was agreed on the basis of a consensus between keeping the validity of the questionnaire and answering some questions of the managers. Such a process of modifying the research design could potentially influence the validity of the method, as the process of transferring the content from the qualitative research into survey statements was affected by the external influencers; however, it was felt that building the relationships with managers and strong cooperation was as important as the validity of the questionnaire. Therefore the researcher allowed this influence to take place.

Based on those limitations, the initial item set had to be substantially pruned. However, this limitation also brought a critical focus to the item selection process. To achieve this, it was decided to apply a number of iterative steps to hone and refine the item set.

1. Unclearly and / or ambiguously stated items were removed.
2. Semantically very similar items were clustered and appraised to select those that best reflected core concepts and the items worded more clearly were left.
3. Items that would not have read-across / relevance to all departments were removed.
4. Items that were considered likely to elicit socially desirable responses (e.g. self-serving attribution effects) were removed.

This procedure reduced the number of items by approximately 50%, to 127.

Prior to formal piloting, the draft question set was subjected to peer review by a panel of Health and Safety experts from the company (N=4). This process provided valuable feedback on the initial draft of the questionnaire, highlighting areas of ambiguity regarding semantics, as well as the technical content of question items and their appropriateness. This process reduced the number of items to 55. This list of items was then presented to members of the senior management team, who expressed their preference over which items they would like to find out the answer for. This process was important for the organisation, as the management had their own agenda of priorities related to safety and wanted the results of the questionnaire to provide information related to their priorities. While it could be argued that this level of managerial involvement might introduce a bias into the issues addressed, without this level of oversight the data gathering would not have been permitted. Additionally, it is held that involving the senior management team in this way had the potential to increase their ownership of the results and increase buy-in to actions taken on the basis of the findings, including the interventions planned in later stages of the research (see Chapters 7 - 8). After these consultations the number of items was reduced to 31 and minor amendments were made in accordance with the feedback given by managers.

6.2.1. Cognitive piloting of the question set

It was considered that the most appropriate strategy would be to conduct a detailed piloting exercise, involving direct feedback by means of interviews with employees. Due to the costs of taking workers off their work, feedback was derived from individual (interview) rather than group elicitation. Feedback from shop-floor employees was gathered via individual interviews with volunteers from each department (N=10). A total of ten respondents agreed to complete the draft questionnaire and highlight those items that they considered required revision pursuant to the following criteria:

1. items that could be considered to contain ambiguities,
2. items that lacked clarity or that were in any way confusing,
3. items that were poorly written, unclear or otherwise difficult to understand,
4. typographical errors and omissions,
5. appropriateness of respondent – group demographic classification.

The pilot sample consisted of ten people working in ten largest departments (Small Wax, Large Wax, Monoshell, Mould Wrap, Foundry, Small Finishing, Large Finishing, Cleaning, Alloy Plant, Ceramic Core).

The conclusions that emerged from the process were noted by the researcher for subsequent revision and inclusion in the final draft of the questionnaire. This process revealed the need for a limited number of revisions to items and one item was removed, giving a revised total of 30 items. The opinions expressed by the pilot respondents were predominantly positive towards the questionnaire in terms of its format, the wording of the items and the issues that it sought to address.

6.2.2. Issues of response set

The item set was further appraised with respect to the potential for bias attributable to the response, set i.e. “the tendency of a person to respond to questions in a particular way independently of the content of the questions or, as conventionally termed, items… for example, the tendency to agree rather than disagree, or the tendency to make extreme responses” (Rennie, 1982).

Rennie (1982) recommends achieving balance by constructing the items in the set such that there are an equal number that are positively and negatively framed. Consideration was therefore given to the scope for the semantic reversal of items, with a view to producing a questionnaire with 50% reverse scored items. However, there was also a need to consider semantic elements, i.e. to avoid awkward-sounding, overly complex language or recourse to double negatives. 15 items were chosen for reverse coding (see Appendix D).

At this stage in the development process the items were thematically grouped. However, in order to counteract response bias, due to the sequential ordering of thematically related items, the order of presentation was randomised for the survey using the randomisation function in the Microsoft Excel software package.

6.2.3. Item scaling

Questionnaire items were referenced on a five-point Likert scale, with anchor points of “Strongly Agree”; “Agree”; “Neither agree nor disagree/neutral”; “Disagree”; “Strongly disagree” with the five positions being ascribed simple weightings of 5,4,3,2 and 1 respectively. The Likert scale was chosen because it has been empirically demonstrated that this format has strong potential to produce distributions that can be treated as interval data (Carifio, 1978). Five- and seven-point scales are the most commonly encountered in the psychometric measurement of safety culture. As Colman et al., (1997) and Dawes (2008) demonstrated empirically, 5- and 7-point scales appear to produce ostensibly equivalent results so the 5-point scale was chosen on the grounds of simplicity. The scale response anchors were taken from Vagias (2006).

6.3. Selection of method of data analysis

There are three main objectives of the analysis:

1. to explore and understand the structure of a set of variables related to safety culture,
2. to reduce the data set to a manageable size while retaining as much of the original information as possible,
3. to enhance the insight afforded by the thematic analysis of the variables affecting safety culture described in Chapters 4 - 5.

Following precedents set by a number of safety culture studies (Berends, 1996; Cheyne, Cox, Oliver, & Tomas, 1998; Cheyne, Oliver, Tomas, & Cox, 2002; Prussia, et al., 2003; Taylor & Thomas III, 2003), principal components analysis was considered to offer an effective approach that would address the study's aims.

Further justification of the suitability of principal components analysis is offered by Gorsuch (1974) and Stevens (1992). These authors suggest that if the number of variables is 30 or more, and where communalities can be predicted to be low (<.4) and the primary intent is to characterise the data by identifying a small number of underlying dimensions referenced to the common variance (by precedent assumed to be 1), principal component analysis is the most suitable method (Field, 2005). The software used was SPSS ver. 16 for PC.

6.4. Sample size

Ever since 2006, the parent corporation has conducted an employee survey called "Global Voices" in all its locations worldwide. Each company in the group is obliged to offer employees the opportunity to fill out the survey. The survey was anonymous and employees were not obliged to participate.

Permission was obtained to add the safety culture questions to the 2008 and 2009 Global Voices surveys at the plant. It was agreed that the results of the safety culture element would be made available to the company's senior management team both local and corporate and that feedback would be provided to the participants in the form of a summary.

As in previous years, all employees were made aware of the opportunity to complete the annual Global Voices survey through a number of means:

1. graphically enriched emails sent to all email recipients in the company,
2. specially prepared, eye-catching posters put on the notice boards in the majority of departments,

3. supervisors were instructed to publicise the opportunity verbally during shift start-up meetings.

The communication included information about the time and date of the survey administration, the fact that the survey had both the management and the union support and that participation was voluntary and anonymous.

Questionnaires (see Appendix D) were distributed over a two-week period, with respondents being given the opportunity to spend 15-20 minutes of paid time to complete them. Administrators were available in the early morning and in the evening to take account of the rotating three-shift system, so all employees had the opportunity to complete the questionnaire.

The employee response rates for the annual Global Voices survey at the sponsor company (including the safety culture components) were 43% (N=439) and 35% (227) for 2008 and 2009 respectively. It must be emphasised that the survey for this Ph.D. research was embedded in a larger survey over which the researcher had no control. This included representatives from the majority of departments and functional positions (blue-collar, white-collar and managerial grades). Table 11 presents the counts for each position. The chi-square statistic was significant, suggesting that the samples from years 2008 and 2009 differed $\chi^2(5)=14.52$, $p<.05$. In 2009, 50% fewer operators took part in the study.

Table 11. *Position cross-tabulation*

			Position						Total
			operator	team/shift/cell leader	supervisor	manager	office positions	other	
Year	2008	Count	293	34	18	21	42	31	439
		% of Total	40.9%	4.7%	2.5%	2.9%	5.9%	4.3%	61.3%
	2009	Count	147	29	13	23	40	25	277
		% of Total	20.5%	4.1%	1.8%	3.2%	5.6%	3.5%	38.7%
Total		Count	440	63	31	44	82	56	716
		% of Total	61.5%	8.8%	4.3%	6.1%	11.5%	7.8%	100.0%

The Table 12 shows how many employees took part in the survey from particular departments in 2008[11].

[11] For both samples (2008 and 2009) only departments with more than 20 respondents were included for the comparison of inter-departmental differences (see section 6.10).

Table 12. *Number of employees from particular departments that filled out the safety culture questionnaire in 2008*

2008			
Department	Frequency	Number of employees working in departments	Response rate in particular departments
ABS	1	6	17%
Ceramic Core	34	62	55%
Cleaning (prefinishing)	4	61	7%
Core Removal	2	12	17%
Despatch & Packing	2	11	18%
Engineering	12	32	38%
Foundry	38	78	49%
Grain Inspection	7	10	70%
HEA Chem Lab	3	6	50%
HEA Maintenance	5	14	36%
HEA Production	24	47	51%
Heat Treatment	3	23	13%
H&S	2	4	50%
Large Finishing	35	52	67%
Large Wax	47	117	40%
Layout	2	4	50%
Maintenance	4	56	7%
Met Lab	3	11	27%
Monoshell	19	50	38%
Mould prep	8	33	24%
Quality	3	16	19%
Salvage	1	4	25%
Small finishing	19	43	44%
Small Wax	66	103	64%
Stores & Goods in	2	7	29%
Tool Room	1	8	13%
IT	1	6	17%
X-ray	1	33	3%
Other	3	.7	17%
Total	352		

Missing (no info)	87		
Total	439	1021	43%

Table 13 shows how many employees took part in the survey from particular departments in 2009.

Table 13. *Number of employees from particular departments that filled out the safety culture questionnaire in 2009*

2009			
Department	Frequency	Number of employees working in departments	Response rate in particular departments
Ceramic Core	22	48	46%
Cleaning (prefinishing)	25	54	46%
Engineering	10	31	32%
Foundry	26	61	43%
HEA Production	2	42	5%
H&S	1	4	25%
Large Finishing	2	45	4%
Large Wax	36	83	43%
Layout	4	4	100%
Maintenance	6	24	25%
Met Lab	1	10	10%
Monoshell	1	38	3%
Mould Prep	14	24	58%
Quality	2	17	12%
Small Finishing	7	32	22%
Small Wax	27	58	47%
Tool Room	1	6	17%
X-ray	16	27	59%
Other	0	35	
Total	203		
Missing (no info)	24		
Total	227	643	35%

The detailed information about the non-participants was not available. However, the sponsor company was going through turbulent times of difficulties with orders and the process of redundancies. One explanation for the lower number of participants in 2009 is that the job security concerns affected employees' motivations to conduct activities that were outside the scope of their work. However, as no relevant data about the non-participants are available, these explanations can only be hypothetical.

It was considered that the most appropriate strategy to adopt for the main analysis was to perform the analysis on the sample of operators (N=293 in 2008) as the primary sample frame, for the following reasons:

1. They constituted the largest homogeneous proportion of the sample.
2. They were exposed to risks to the highest extent on a daily basis.
3. The majority of accidents involved members of that group.
4. Clarke (1999a) demonstrated that despite a shared perception among the representatives of different levels of organisational hierarchy that safety is important, blue-collar workers, supervisors and managers differed significantly with regard to the relative influence assigned to the various safety issues (see also DeJoy, Murphy, & Gershon, 1995).

There are a number of rules of thumb available in the subject literature regarding sample size for component analysis. Guertin and Bailey (1970) demonstrated that with smaller samples the random errors of the less reliable correlation coefficients increase the absolute size of the correlations in the matrix, which produces greater commonalities and more common-factor variance. Therefore, Comrey (1992) offers the following metric on sample size: 50 cases - very poor, 100 poor, 200 fair, 300 good, 500 very good and 1000+ excellent.

Another rule of thumb suggested by Kass & Tinsley (1979) suggests having between 5 and 10 participants per variable, up to a total of 300. However, other studies (Arrindel & van der Ende, 1985) concluded that neither differences in this ratio nor the number of observations affected component stability.

On the basis of the above criteria, it was considered that the size of the data set should be suitable for Principal Component Analysis.

6.5. Pre-analysis checks for 2008 data

6.5.1. Omission of low-correlating items

The item initial correlation matrix was examined (as suggested by Field, 2005) in order to find items for which the majority of the significance values were greater than .05. No item was found fulfilling this criterion, so there was no need to eliminate any question at this stage of analysis.

6.5.2. Assessment of the appropriateness of the correlation matrix

In order to assess the appropriateness of the initial correlation matrix with regard to its suitability for performing a factor analysis, three statistical tests - the Kaiser-Mayer-Olkin test for sampling adequacy, the Barlett test of sphericity and examination of the diagonal elements of the anti-image correlation matrix - were conducted. Table 14 shows the results of these analyses.

Table 14. *KMO test, Bartlett's Test and the examination of the diagonal elements of the anti-image correlation matrix conducted on the 2008 data.*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.941
Bartlett's Test of Sphericity	Approx. Chi-Square	4286.081
	df	435
	Sig.	.000
Examination of the diagonal elements of the anti-image correlation matrix.		All values above .8

Kaiser (1970) recommends accepting values greater than 0.5. However, the closer the value to 1.0, the better, as it indicates that patterns of correlations are compact increasing the chance that the factor analysis will yield reliable and distinct components.

It has been recommended that Barlett’s test of sphericity be significant (Ferguson & Cox, 1993), as this suggests that the R-matrix is not an identity matrix and thus that there are relationships between the variables that may be included for analysis.

The above checks confirmed that the data set was suitable for factor analysis.

6.5.3. Method of factor rotation

In order to achieve a simple, orthogonal structure, Varimax was selected as the method of factor rotation, as this is considered the best of the orthogonal rotation procedures (Tinsley & Tinsley, 1987). The orthogonal type of rotation was used over the oblique factor solution as the latter requires the explanation of both latent dimensions underlying each factor and the latent dimensions underlying the correlations among the factors (Tinsley & Tinsley, 1987). As these explanations could not be provided at this stage of analysis, an orthogonal rotation was chosen.

6.5.4. Suppression of low-loading items

Although it has been argued that there is a precedent amongst researchers of setting an item loading inclusion criterion of >0.3, it needs to be emphasised that the significance of loading is dependent on sample size (Field, 2005). Stevens (1992) calculated that a loading greater than .298 for samples ≥300 is appropriate, but he also suggests applying a cut-off point of factor loading values at .4, as it would be appropriate for interpretive purposes. Additionally, Field (2005) suggests suppressing loadings lower than .4, as it simplifies the interpretation of the results. In the light of these recommendations, all items loading below 0.4 were suppressed from the rotated matrix output.

6.6. Derived components – constituent items

Tables below show the list of items for each of the derived components, generated from the sample of shop-floor workers. Discrete items are presented in normal type and cross-loading items in *italics*.

Table 15. *Initial principal component analysis – listing of items and their loadings, Component 1.*

	Component 1	Loading
Q.27	The supervisors in my department frequently check to see if all employees are obeying the safety rules	.795
Q.28	The supervisors of my department discuss how to improve safety with operators	.720
Q.25	The supervisors in my department lead by example in complying with safety rules	.678
Q.26	There are good communications in my department about safety issues	.668
Q.8	People in my department get regular praise for working safely	.538
Q.6	My supervisor regularly reminds operators to work safely	.518
Q.14	The managers of my department see safety as the number one priority when setting production speeds and schedules	.424
Cross-loading items		
Q.21	*When you report safety problems the management of the department are quick to give feedback on what actions have been taken* (Component 2)	*.489*

Q.15	*Newcomers in my department receive good-quality- training on the risks associated with their job* (Component 2)	*.420*
Q.2	*The management of my department are genuinely concerned about the health and safety of employees* (Component 2)	*.453*

Table 16. *Initial principal component analysis – listing of items and their loadings, Component 2.*

	Component 2	Loading
Q.4	Managers in my department place a high priority on fixing safety problems identified by operators	.710
Q.1	Most of the time I have all the necessary resources to do my job safely	.694
Q.7	In my department when you ask for safety things to be fixed they usually get sorted quickly	.647
Q.16	Accident investigations in my department are generally effective in identifying the root causes of incidents	.546
Q.22	In my department safety problems are only addressed when there is going to be a safety audit	.530
Q.17	In my department, what operators have to say about safety problems is not taken into consideration	.437
Cross-loading items		
Q.21	*When you report safety problems the management of the department are quick to give feedback on what actions have been taken* (Component 1)	*.406*
Q.15	*Newcomers in my department receive good quality training on the risks associated with their job* (Component 1)	*.402*
Q.2	*The management of my department are genuinely concerned about the health and safety of employees* (Component 1)	*.554*
Q.10	*In my department safety is sometimes sacrificed for the sake of production* (Component 3)	*.431*

Table 17. *Initial principal component analysis – listing of items and their loadings, Component 3.*

	Component 3	Loading
Q.12	Sometimes I feel under pressure from my workmates to work in an unsafe manner	.790
Q.13	People in my department often take risks by cutting corners with safety	.771
Q.23	In my department people regularly take risks to achieve output targets	.679
Q.11	The supervisors in my department sometimes encourage operators to take risks	.639
Q.9	The supervisors of my department sometimes allows “favourite” employees to break safety rules	.565
Q.20	In my department supervisors often turn a blind eye to unsafe practices	.533
Cross-loading items		
Q.10	*In my department safety is sometimes sacrificed for the sake of production* (Component 2)	*.571*

Table 18. *Initial principal component analysis – listing of items and their loadings, Component 4.*

	Component 4	Loading
Q.29	Where I work people are reluctant to report minor injuries	.743
Q.5	There are some safety problems in my department that have not been solved for a number of years	.599
Q.30	In my department hazards only tend to be removed after somebody has had an	.577

	accident	
Q.19	The supervisors of my department tends to blame people who have an accident	.555

6.7. Naming components

6.7.1. Component 1

In Component 1, each item is related to leadership – both supervision and management. The constituent items relate to relational aspects of leadership, i.e. situations in which leaders directly interact with their subordinates by checking compliance with safety rules, discussing safety problems, leading by example, communicating, praising, reminding staff to work safely, and giving feedback. Two out of the three cross-loading (with Component 2) items (Q.21 and Q.2) seem to have greater face validity with regard to Component 1 than item Q.15. Therefore these items were considered to be constituent element of Component 1. Based on the review of the content of items, this component was called "**interactional leadership**". This component directly refers to the theme identified in thematic analysis in Chapter 5, called "leadership", and the two categories appear to cover similar content.

6.7.2. Component 2

Component 2 includes six items. They appear to emphasise the managerial approach and degree of commitment ascribed to fixing safety problems, providing resources and investigating the roots of accidents (the flaws of the safety system that led to an injury), reacting to employees' reports and reacting to corporate initiatives such as audits. One item (Q.15), cross-loaded on Component 1, was considered to have better face validity with Component 2 than with Component 1, as it referred to training on risks, so it was included in the group of items constituting the second component. These items refer to the theme "reactive approach" derived from the analysis of focus groups, which is about solving problems in reaction to accidents or corporate audits. As the second component is about timely **"solving safety problems,"** that is the name of the component.

6.7.3. Component 3

Component 3 consists of six discrete items and one cross-loading item (Q.10). The content of this item (Q.10) is very similar to the other six discrete items, and since it has high face validity, it will be added to the group of six discrete items. All items refer to risk taking, breaking rules and working in an unsafe manner. To this extent it overlays the content of the "breaking rules" theme identified in the focus group study (see Chapter 5). The constituent elements of this component were therefore assigned the label of "**risk taking"**.

6.7.4. Component 4

Component 4 consists of four items that appear to represent two sub-themes. The first refers to blaming workers for having accidents and (possibly as a result) workers' reluctance to report injuries. The second sub-theme refers to managers not solving safety problems and not removing hazards. However, looking beyond the literal meaning of the items, it seems possible to interpret this combination of items as being related to some sort of detachment that implies lack of involvement, disinterest and indifference on the part of employees. In this respect it may be that this component can be cast as relating to the spectrum of involvement/participation or engagement. The items suggest a lack of proactive response, perhaps almost a "sense of helplessness" on the part of employees, with plausible links to the concept of self-efficacy. Therefore this component will be labelled **"estrangement".**

6.8. Summary of component structure

The initial component extraction revealed a total of four components. These components were found to account for 51.734% of the total variance, as shown in the table 19:

Table 19. *Rotation Sums of Squared Loadings*

Component	Total	% of Variance	Cumulative %
Component 1 – Interactional leadership	4.439	14.798	14.798
Component 2 – Solving safety problems	4.128	13.761	28.559
Component 3 – Risk taking	3.986	13.286	41.846
Component 4 - Estrangement	2.966	9.888	51.734

The table below shows the reliability of components expressed in terms of alpha coefficients.

Table 20. *Reliability analysis*

Component	No of items	Alpha
Component 1 – Interactional leadership	8	.876
Component 2 – Solving safety problems	7	.852
Component 3 – Risk Taking	7	.893
Component 4 - Estrangement	4	.708

6.9. Results

6.9.1. Comparison of demographic grouping

Given the exploratory nature of this study and the evidence of sub-cultural differences between different parts of the organisation (see also Chapters 4 and 5), the derived scales were used to test this formally. The subject literature and previously obtained results provide some suggestions with regard to areas for further investigation:

1. Clarke (1999a) suggests that there may be a difference between personnel in functional positions with regard to their perceptions of safety, consideration was given to probing the differences between grades in hierarchy of the company.
2. Fleming, Flin, Mearns, & Gordon (1998) and Weyman & Clarke (2003) suggest the potential for differences between parts of an organisation, functional units or departments. They refer to these dissimilarities as “subcultures”. Based on their findings, an exploration of variation between departments was conducted.
3. As there are two data sets available from 2008 and 2009, the comparison between perceptions of safety culture obtained in two different time periods will be explored, as within the period between 2008 and 2009 the company went through a number of changes (including redundancies and leadership modifications) that could possibly affect employees’ perceptions. Hence a comparison with regard to the differences between functional positions will be conducted using the previously derived component structure by means of one-way and two-way ANOVA.

4. Additionally, based on the same rationale, a comparison of the differences between different departments will be conducted.

6.9.2. Comparison of job grades

Survey respondents assigned themselves to one of five functional positions (operator, team/shift leader, supervisor, manager and office employee). While it could be hypothesised that there would be differences among groups, where these difference lay could not be established. Therefore, ANOVA with *post hoc* tests was applied to compare means between these groups on each of the components. Following established precedents (Field, 2005), component scores were derived by summing the rating of the each constituent item for every respondent on every component.

As there were large differences between groups in terms of sample sizes, Hochberg's GT2 test was used, as advised by Field (2005). Levene's test revealed that the variances between components were not significantly different (Levene's test not significant for all components, $p>.05$).

The ANOVA results show that there were significant differences ($<.000$) between groups in the 2008 and 2009 data sets with the effect size[12] range between .024 and .031 for 2008 and .035-0.46 for 2009. F values, sums of squares, degrees of freedom and means square are provided in Appendix D for all components in 2008 and 2009.

Hochberg's GT2 test calculated for the 2008 data and Gabriel's test for the 2009 data provided information on differences between groups. Tables with comparisons between all groups, mean differences, standard errors, significance values and lower and upper bounds of the 95% confidence interval are available in Appendix D. A common pattern emerged from the comparisons: for all components, groups of operators and team leaders differed significantly from the groups of leaders (supervisors, managers) and office positions. A detailed analysis is presented below.

Component 1 – Interactional leadership

2008

There were significant differences between operators and supervisors ($p=.002$) and managers ($p=.001$). There was also a difference between a group of

[12] Calculated with an equation of omega squared (ω^2) (Field, 2005):

$$\omega^2 = \frac{SS_M - (df_M)MS_R}{SS_T + MS_R}$$

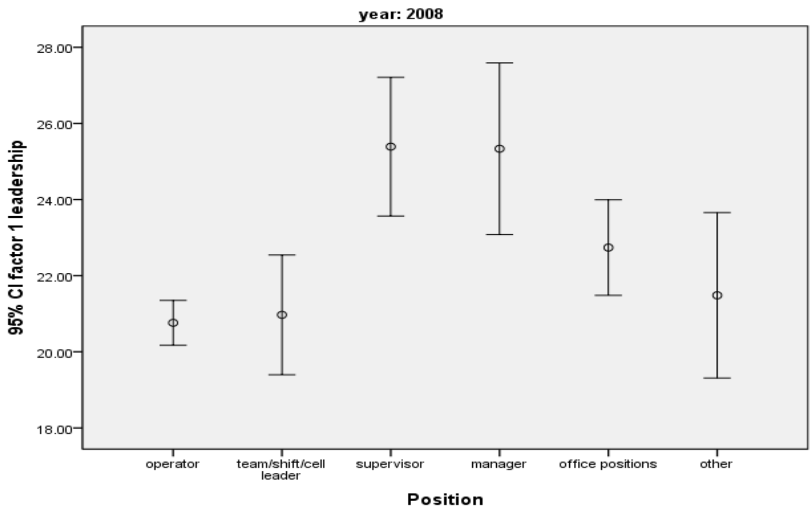
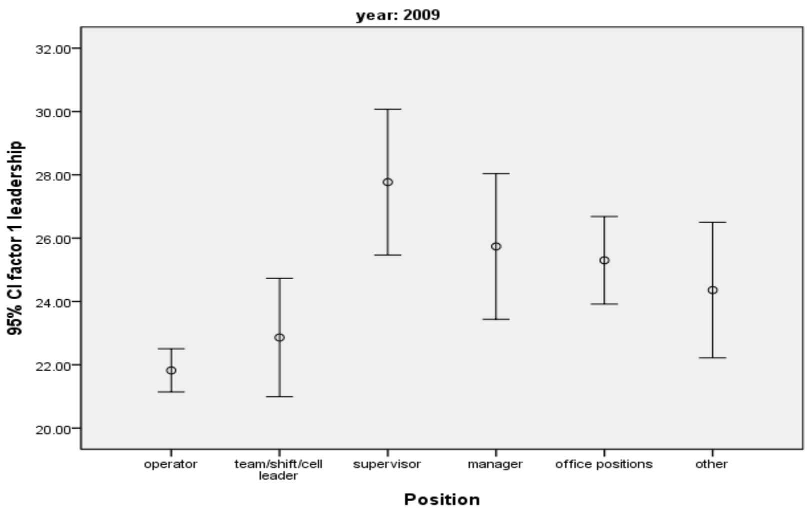
team/shift/cell leaders and supervisors (p=.035) and managers (p=.024) (see Table 21).

2009

There was a significant difference between a group of operators and supervisors (p<.000), managers (p<.000) and office positions (p<.000). There was also a difference between a group of team/shift/cell leaders and supervisors (p=.013) (see Table 21).

The direction of the differences is easy to notice on the error bars with 95% confidence interval:

Table 21. *95% confidence interval error bars of scores obtained by particular functional positions on Component 1 in 2008 and 2009*

	2008
Component 1	
	2009
Component 1	

These results suggest that there is a significant difference (see results above) between perceptions of leaders' safety-focused interactions between groups of blue collar and white-collar employees. Operators and team leaders perceive managers' safety focused actions more negatively than managers themselves and office employees.

Component 2 – Solving safety problems

2008

There was a statistically significant difference between operators and managers (p=.001) and office employees (p<.000). There was also a difference between team/shift/cell leaders and managers (p=.001) and office employees (p<.000) (see Table 22).

2009

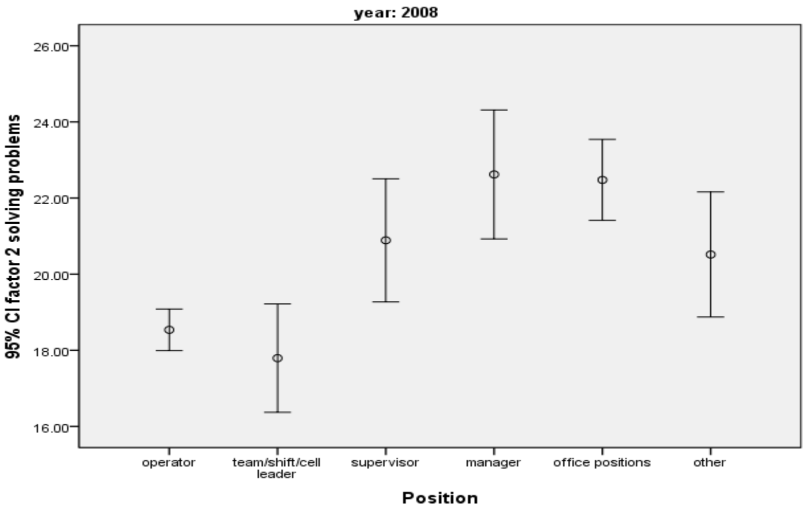
There was a significant difference between operators and supervisors (p=.002), managers (p<.000) and office employees (p<.000). The group of shift/team/cell leaders also differs significantly from the following three groups: supervisors (p=.006), managers (p=.001) and office employees (p=.004) (see Table 34).

The error bars (Table 22) show that, similarly to Component 1, the means of groups of operators and team leaders are lower than the means of managers and office employees. With regard to the content of the component, these results suggest that employees working physically perceive actions to solve safety-related problems as being less effective than groups of leaders.

Table 22. *95% confidence interval error bars of scores obtained by particular functional positions on Component 2 in 2008 and 2009*

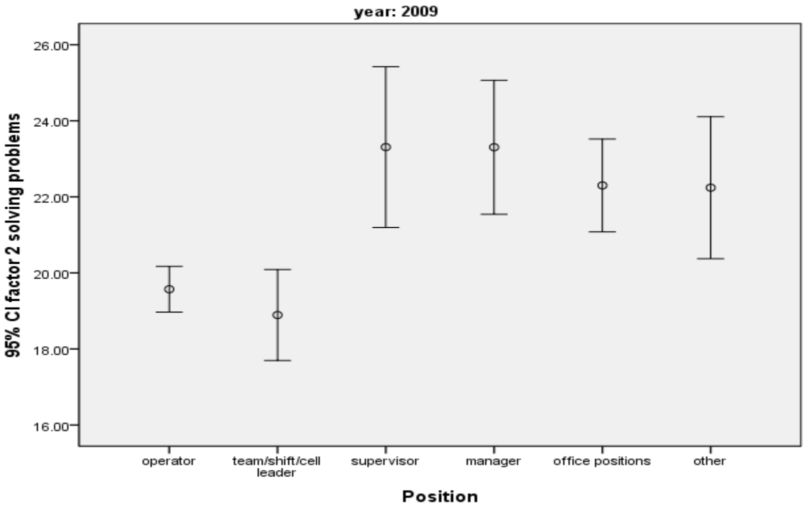
2008

Component 2



2009

Component 2



Component 3 – Breaking rules

2008

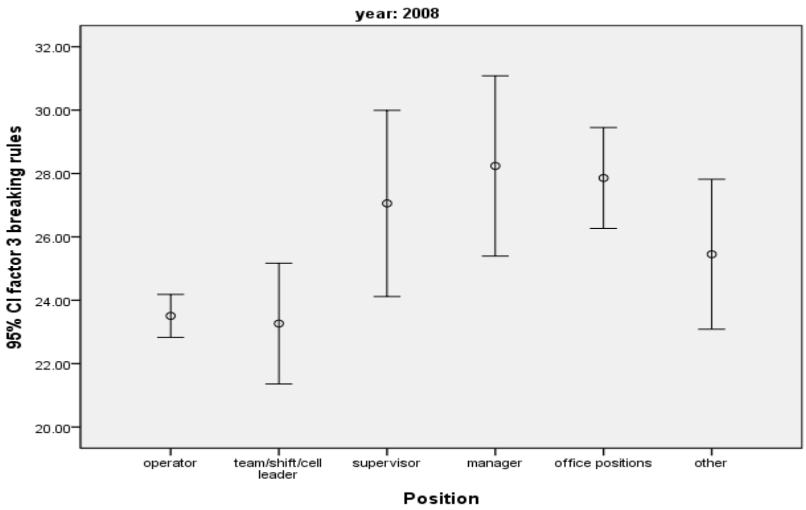
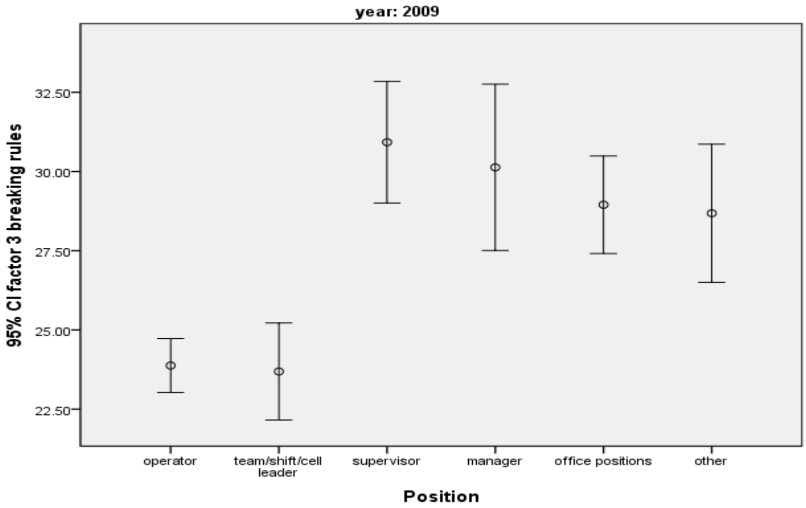
There was a significant difference between operators and managers (p=.006) and office employees (p<.000). There was also a difference between team/shift/cell leaders and managers (p=.033) and office employees (p=.011) (see Table 23).

2009

There was a difference between operators and supervisors (p<.000), managers (p<.000) and office employees (p<.000). There was also a difference between team leaders and supervisors (p<.000), managers (p<.000) and office employees (p=.005) (see Table 23).

The error bars again (Table 35) show the difference between physically working employees and leaders. These results suggest that operators tend to admit more frequently than leaders that people in their departments take risks and break safety rules.

Table 23. *95% confidence interval error bars of scores obtained by particular functional positions on Component 3 in 2008 and 2009*

	2008
Component 3	
	2009
Component 3	

Component 4 - Estrangement

2008

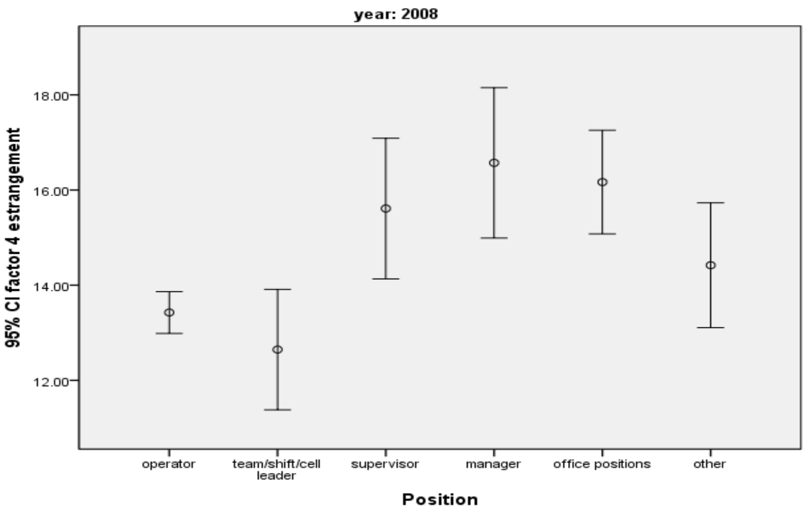
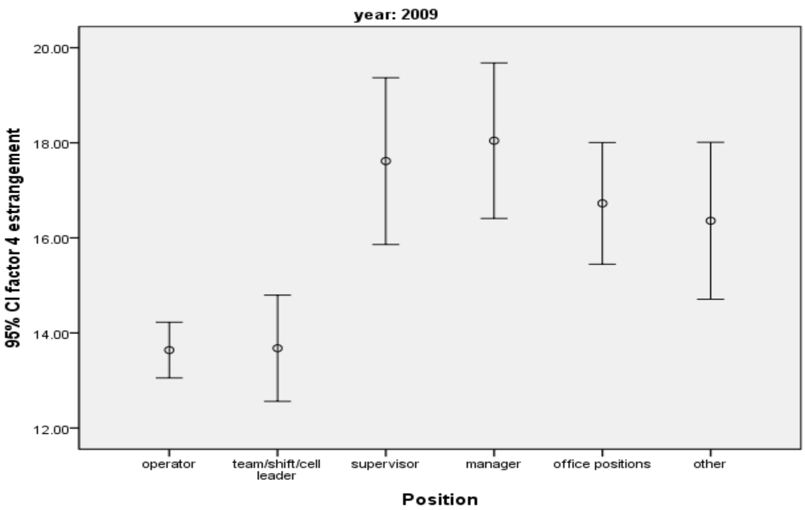
There was a significant difference between operators and managers (p=.002) and office employees (p<.000). There was also a difference between team/shift/cell leaders and managers (p=.002) and office employees (p=.001) (see Table 24).

2009

There was a difference between operators and supervisors (p<.000), managers (p<.000) and office employees (p<.000). There was also a difference between team leaders and supervisors (p<.016), managers (p<.000) and office employees (p=.010) (see Table 24).

With regard to estrangement (see Table 24), the results suggest that operatives and their co-workers team/shift/cell leaders feel more disengaged compared to supervisors, managers and office employees, indicating that they tend to feel blamed for having accidents and are reluctant to report injuries, also stating that there is a reactive approach to safety.

Table 24. *95% confidence interval error bars of scores obtained by particular functional positions on Component 4 in 2008 and 2009*

<table>
<tr><th colspan="2">2008</th></tr>
<tr><td>Component 4</td><td>
</td></tr>
<tr><th colspan="2">2009</th></tr>
<tr><td>Component 4</td><td>
</td></tr>
</table>

6.9.3. Interpretation

In both the 2008 and 2009 data sets the pattern of differences was very similar. The strongest difference was between groups of operators/team leaders and groups of supervisors, managers and office workers.

All the errors bars above show that blue-collar respondents (operators and team/shift/cell leaders physically working on the shop floor) have significantly lower scores on all four components compared to those in white-collar (office) and management positions. Additionally, investigating the differences between 2008 and 2009, it can be seen that in 2008 groups of operators/team leaders do not differ from the group of supervisors (except on Component 1) whereas in 2009 differences are apparent between blue-collar workers and other groups on all components.

6.9.4. Two-way ANOVA

In order to explore the potential interaction between the year of survey (2008 and 2009) and a job grade (independent variable), a two-way ANOVA was conducted for each component. A Levene's test was conducted in order to test for the homogeneity of the data, and this revealed a significant value for Components 1 and 2. To address this issue, Welch's and Brown-Forsythe's tests were conducted. These tests modify F and the residual degrees of freedom, and by doing so deal with the problems arising from violations of the homogeneity-of-variance assumption. The significance value for both tests for Components 1 and 2 was below the $p<.05$ threshold, so it allowed the null hypothesis to be rejected and effectively permits the continuation of the analysis. The pattern of results revealed by the two-way ANOVA for Components 1,2,3, and 4 was identical: there was a significant main effect of year and position on the component scores. Additionally, there was no significant interaction between the year and position. This indicates that people at different positions at the company were similarly affected by the changes occurring in 2008 and 2009.

6.10. Comparison of inter-departmental differences

As mentioned earlier, there is some evidence suggesting the potential for cultural differences within the same company or even within organisational units (Fleming, et al., 1998; Weyman & Clarke, 2003). In order to test this premise, two one-way ANOVAs were conducted on the data obtained in 2008 and 2009. As was the case with issues surrounding comparisons between job roles, at this stage of the investigation it was not possible to determine the direction of difference. Therefore a *post hoc* test was used to explore the differences.

For the further analysis, only departments with more than 20±1 people were chosen. Nine departments from the 2008 survey fulfilled this criterion, but only five departments from the 2009 data set fulfilled it. Levene's test of homogeneity of variance was significant for Components 1 (.033) and 2 (.031) for the 2008 data set, which means that ANOVA's assumption that variances are homogeneous was broken. Values of Levene's Statistic, degrees of freedom and significance of the test for the 2008 and 2009 data sets may be found in Appendix D.

The ANOVA test revealed significant differences between all departments for the 2008 data set. For Component 1, the difference was expressed in $F(8,277)=2.319$, $p<.05$, $\omega^2=.018$, for Component 2 $F(8,269)=7.807$, $p<.000$, $\omega^2=.040$, for Component 3 $F(8,278)=3.627$, $p<.000$, $\omega^2=.026$, for Component 4 $F(8,269)=3.552$, $p<.001$, $\omega^2=0.26$. Values of sum of squares and mean squares may be found in Appendix D.

For the 2009 data set, the ANOVA test did not reveal differences between departments in Component 1 $F(4,131)=.545$, $p>.05$, ω^2 =was negative and no square root calculation could be performed. For Component 2 $F(4,129)=4.980$, $p<.001$, $\omega^2=.032$, for Component 3 $F(4,129)=2.834$, $p<.05$, $\omega^2=.022$ and for Component 4 $F(4,130)=3.439$, $p<.05$, $\omega^2=.025$. Values of sum of squares and mean squares may be found in Appendix D.

The ANOVA results indicated significant differences between all components in the 2008 data set and between all components in 2009, except Component 1. However, ANOVA does not provide information on between which groups the differences are. Therefore, *post hoc* tests were conducted. The Games-Howell test was performed on the 2008 data set, as it does not rely on homogeneity of variance. For the 2009 data set Gabriel's test was performed as advised by Field (2005) as the best test for comparing slightly different sample sizes. The significant differences between departments will be discussed below within every component. The values of mean differences, standard errors and the bounds of the 95% confidence interval may be found in Appendix D.

Component 1 – Interactional leadership

2008

There were significant differences between ceramic core and foundry ($p<.05$), mould preparation ($p<.05$). There was also a significant difference between the alloy production and mould preparation ($p<.05$) departments (see Table 25).

2009

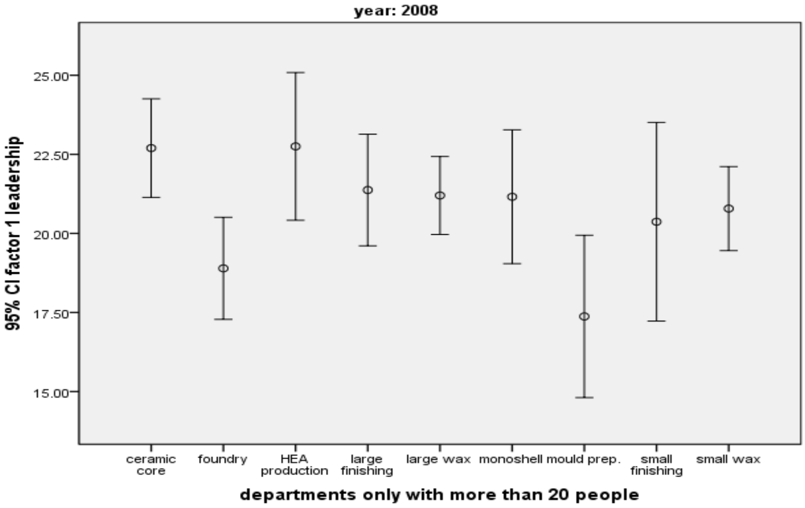
There were no statistically significant differences between departments based on the 2009 data set (see Table 25).

It is important here to refer to information included in Chapter 1 regarding the management structure and location set-up of the plant. The whole site is divided into four separate buildings that contain a number of departments responsible for different stages of production. The main building is responsible for the preparation of moulds, casting and cleaning cast moulds. The following departments belong to this building: foundry, large finishing, large wax, monoshell, mould preparation, small finishing and small wax. Alloy production is placed in a separate building with ceramic core. These two departments are much smaller, employing about 100 people in total, which is a much lower number in comparison to the casting plant, which employed about 600. In terms of management structure, alloy production and ceramic core used to be managed by different directors and alloy production was financially independent. People in every day conversations refer to these differences by distinguishing their identities with saying “we” and “they”. It is also acknowledged by the management that there are important differences between alloy/core and casting. The managers attribute these differences to the relatively greater ease of managing smaller groups of people who, in this instance, also benefit from a superior availability of resources. Also, as these departments employ a smaller number of people, there is easier access to the management and more frequent contact, so there is a higher probability of developing personal relationships with leaders. Additionally, the author’s experience was that there appeared to be higher group cohesiveness in this department as majority of people knew their co-workers personally, which cannot be said about some other departments, e.g. large finishing. Stronger identity with the workplace, stronger feelings of belonging and group cohesion may be partially responsible for the differences. However, these are the perceptions of the author based on long-term observation and interaction with these departments, informal meetings and discussions and observations rather than empirical data.

Table 25. *95% confidence interval error bars of the scores obtained by particular departments on Component 1 in 2008 and 2009*

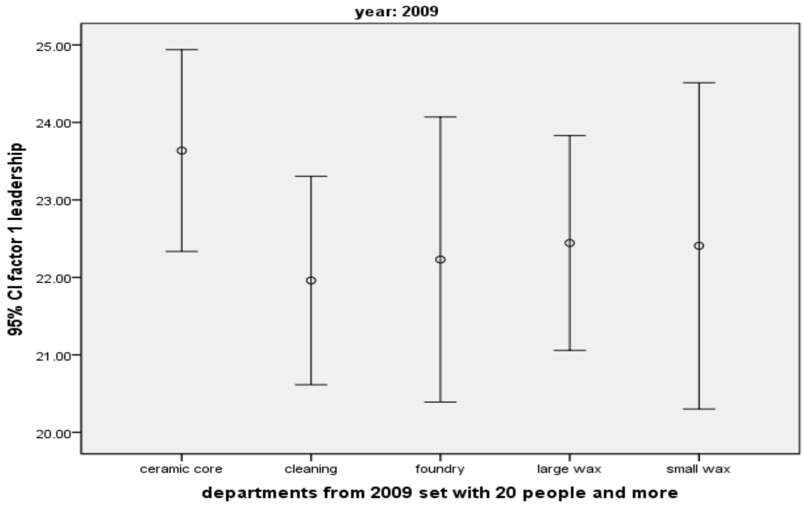
2008

Component 1



2009

Component 1



With regard to the perceptions of leadership and managers' safety-related interactions with operatives, there were differences between ceramic core/alloy production and foundry/ mould preparation in 2008, but no differences in 2009 (see Table 25). In 2008 there was a clear division between organisational units. It is felt that this may also reflect differences between departments in terms of opportunities for direct interaction between managers and staff.

Note: Foundry and alloy production were later selected as the study groups for safety culture improvement intervention (see Chapter 7). This permitted further exploration and empirical insight into the nature of the differences.

Component 2 – Solving safety problems

2008

There were significant differences between ceramic core and foundry ($p<.000$), large finishing ($p<.000$), large wax ($p<.000$), monoshell ($p<.05$), mould preparation ($p<.001$) and small wax ($p<.009$). There was also a significant difference between foundry and alloy production ($p<.000$), between alloy production and large finishing ($p<.002$), large wax ($p<.05$) and mould preparation ($p<.001$). Also between mould preparation and small wax ($p<.05$) (see Table 26).

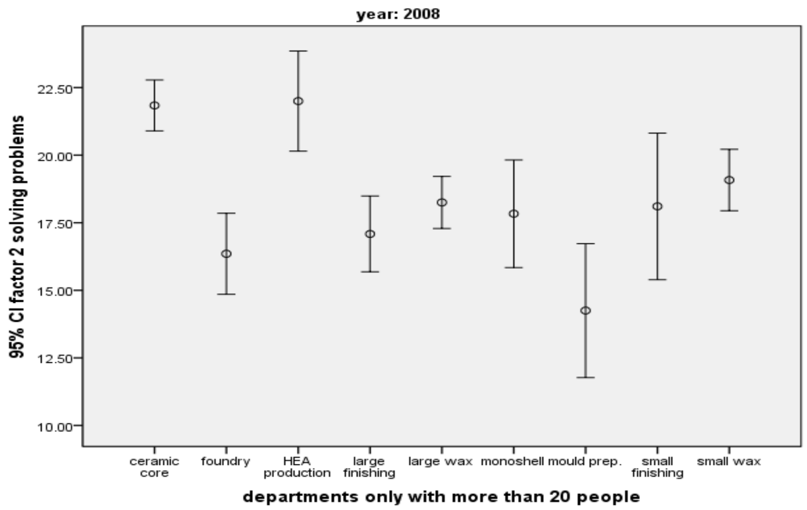
2009

There were statistically significant differences between ceramic core and cleaning ($p<.001$) and large wax ($p=.005$) (see Table 26).

Table 26. *95% confidence interval error bars of the scores obtained by particular departments on Component 2 in 2008 and 2009*

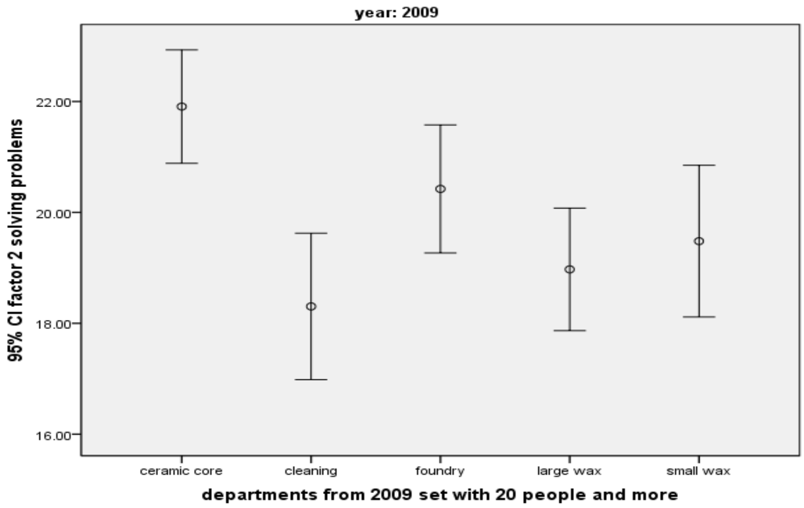
2008

Component 2



2009

Component 2



Component 2 refers to a range of activities undertaken by the company to solve safety problems, remove hazards, identify the root causes of accidents and prioritise fixing the issues identified by operators. There is much diversification between departments. The most satisfied with the company safety management were ceramic core and alloy production – two departments in separate locations. However, even within the casting plant there were statistically significant differences between, for example, mould preparation and small wax. These differences clearly present the diversity of perceptions of employees in various departments. It is considered that this may be a reflection of how the departments differ in terms of their approach to solving safety issues even within the same company. Middle managers and supervisors are mainly responsible for undertaking safety management actions characterised in the questionnaire items, so it may be argued, as there are different groups of people managing departments, that the results mirror perceptions of the efficiency and engagement of leaders in fixing safety issues. An alternative explanation could invoke an unequal distribution of supportive resources such as money and maintenance within those departments. These differences are still visible in 2009, although a smaller number of departments took part in the study.

Component 3 – Breaking rules

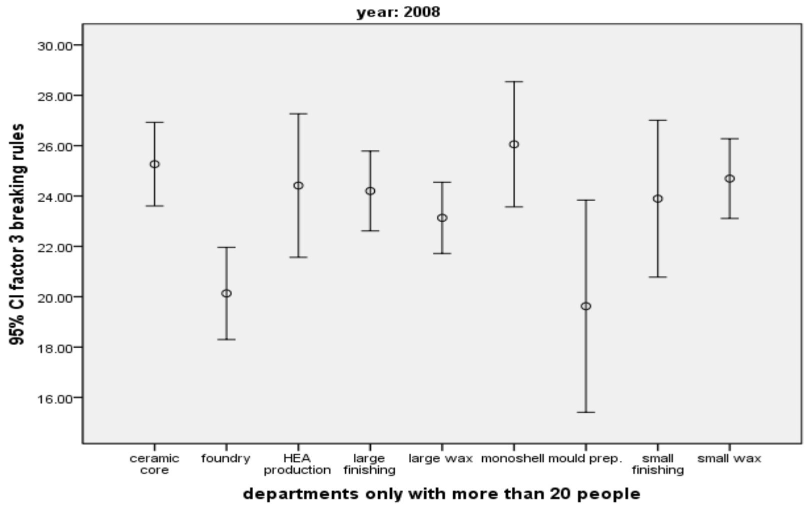
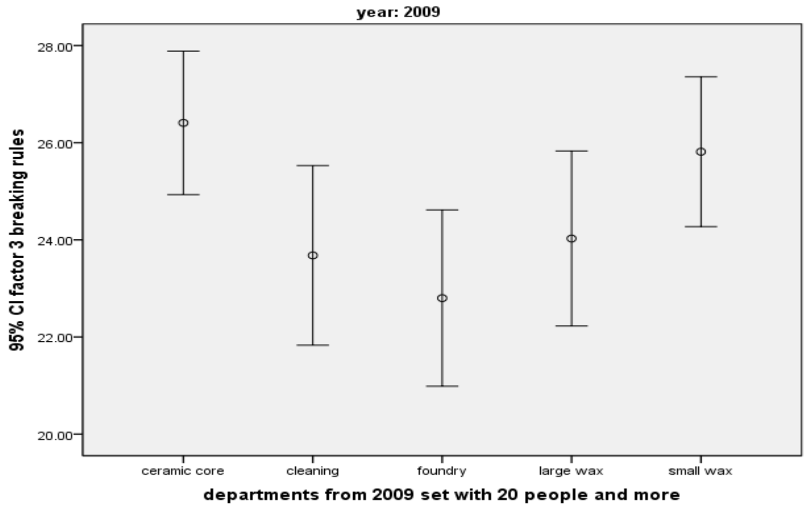
2008

There were significant differences between ceramic core and foundry ($p<.01$), and between foundry and large finishing ($p<.05$), monoshell ($p<.01$) and small wax ($p<.01$) (see Table 27).

2009

There were no statistically significant differences between the departments based on the 2009 data set (see Table 27).

Table 27. *95% confidence interval error bars of the scores obtained by particular departments on Component 3 in 2008 and 2009*

	2008
Component 3	
	2009
Component 3	

With regard to risk taking and breaking safety rules there are again differences between different location units, as well as within the same organisational unit. Items that constitute this component refer to taking risks to meet production goals, informally allowed by supervisors. The foundry has the lowest score compared to other departments in the casting plant. The ceramic core, although different from the foundry, is at a similar level as other departments from the casting plant.

Component 4 - Estrangement

2008

There were significant differences between ceramic core and foundry (p<.01). Also, between foundry and alloy production (p<.01) (see Table 28).

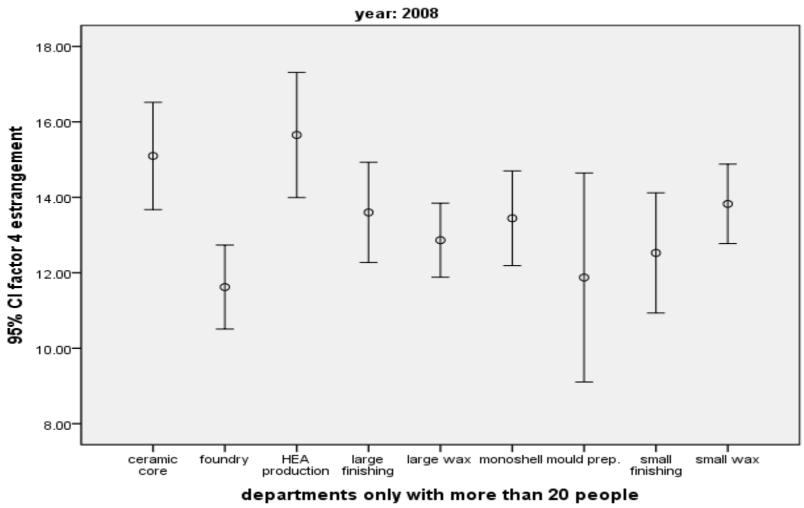
2009

There were statistically significant differences between ceramic core and cleaning (p<.05) and large wax (p<.05) (see Table 28).

Table 28. *95% confidence interval error bars of the scores obtained by particular departments on Component 4 in 2008 and 2009*

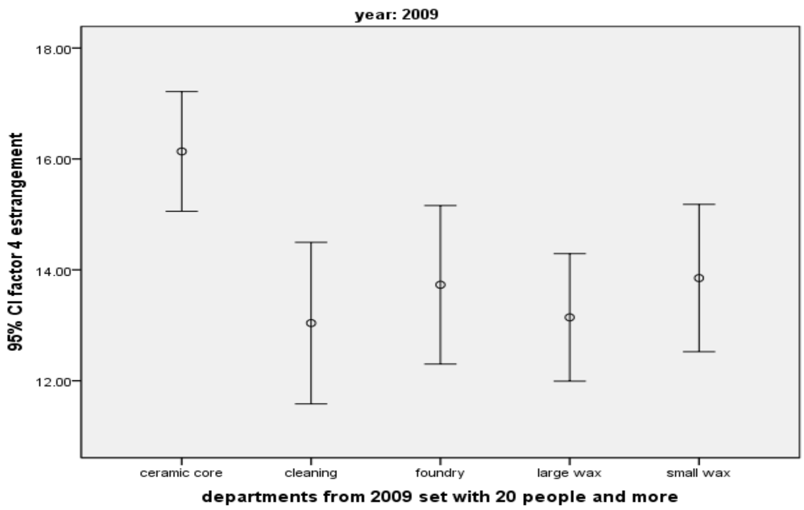
2008

Component 4



2009

Component 4



The estrangement that is expressed in the reluctance to report injuries and the reactive approach to safety differs between the foundry and ceramic core and alloy production. The foundry clearly has the worst results out of all the departments, creating a big gap between other departments. This again could be attributed to the attitudes and actions of the leaders managing those departments.

6.10.1. Two-way ANOVA

In order to explore the potential interaction between year and departments a two-way ANOVA was conducted for every component including year (2008 and 2009) and department as the independent variables. Similarly to the comparison of job grades the pattern of results was identical for all four components, showing that there was a significant main effect of year and department on particular components, but there was no significant interaction between year and department. This suggests that people in different departments were affected by changes happening in the company in 2008 and 2009 to an equivalent degree. A table with the results of the analysis may be found in Appendix D.

6.10.2. Discussion

The presence of significant differences between different groups of employees in terms of their perceptions of safety culture appear to confirm the literature regarding the existence of so-called “sub-cultures” within the same organisational unit.

Moreover, all four components refer in some degree to the direct or indirect engagement of leaders with safety. Therefore it may be hypothesised that the differences between departments stem from differences in leadership style, prioritising problems and solutions and abilities to build meaningful relationships with operatives. Additionally, it appears that leadership style is a combination of the individual properties of a manager or supervisor and the expectations and leadership style of their superior. However, this is a hypothesis for future research.

6.11. Comparison of 2008-2009 differences within job grades

6.11.1. Operator

On average, perceptions of operators in regard to leadership (Component 1) and solving problems (Components 2) were higher in 2009 (F1: M=21.8, SE=.34; F2: M=16.6, SE=.3) than in 2008 (F1: M=20.7, SE=.29; F2: M=18.5, SE=.27). These differences are significant (F1: $t(348)=-2.32$, $p>.05$; F2:$t(349)=-2.52$, $p>.05$) with an effect size[13] of $r=.12$ for Component 1 and $r=.13$ for Component 2.

6.11.2. Team/shift/cell leader

There were no significant changes in the perception of safety-related components in the group of team/shift/cell leaders between 2008 and 2009.

6.11.3. Supervisor

There was a significant difference ($p<.05$) in the perception of risk taking (Component 3) in the group of supervisors between 2008 ($M=27$, $SE=1.39$) and 2009 ($M=30.9$, $SE=.88$) with an effect size of $r=.37$, $t(29)=-2.142$.

6.11.4. Manager

There were no significant differences in the group of managers between 2008 and 2009 with regard to any component.

6.11.5. Office positions

There was a significant change ($p<.01$) in the group of office workers with regard to the perception of leadership (Component 1) between 2008 ($M=22.7$, $SE=.62$) and 2009 ($M=25.3$, $SE=.68$) with an effect size of $r=.29$, $t(80)=-2.777$.

6.11.6. Discussion

The company involved in the study is part of a multi-national corporation that prides itself on having low accident rates and safety as one of the main company values. It is expected that all plants belonging to the corporation will have an on-going programme of initiatives in order to improve the level of safety continually. Some of the safety initiatives are developed at the corporate level and imposed on plants (e.g. IFE books); others come from the initiative of local safety teams, and others stem from the engagement of particular managers and supervisors. This results in a complex array of different “interventions” that engage different people, in different ways, on different issues, going on at any one time. It was not feasible for the author of this research to follow or control every attempt made to improve safety in every department. However, to gather insight and understanding of the variety of

[13] Calculated with an equation of r for t-test (Field, 2005): $r = \sqrt{\frac{t^2}{t^2 + df}}$

processes, regular informal interviews/conversations were conducted with various managers to find out about safety improvement actions. There were differences in terms of the array of safety improvement interventions that were live between 2008 and 2009 across different groups of employees. As the majority of respondents come from departments not involved in the author's intervention, the variables affecting the change were not controlled. However, it is possible to account for the differences by hypothesising about potential change triggers. Based on the afore mentioned conversations with managers, a list of formal safety-initiative-related actions undertaken by middle managers between 2008 and 2009 was created. It is worth emphasising that, from a practical point of view, it was not important to the company to attempt to measure all these initiatives, as that would consume a lot of resources. Hence it is not possible to deduce which, if any, of these initiatives and interventions had a significant impact on safety performance.

Apparently, in response to the results of the safety culture questionnaire in 2008 and the "Global Voices" survey performed at the same time, managerial awareness about safety-related issues and employees' negative perceptions of safety culture had the effect of increasing the focus on ways to improve performance. As a result:

1. More resources were assigned to addressing IFE issues raised. Every single IFE was reviewed personally by a senior manager who prioritised which one to solve first and assigned resources, often based on inter-departmental cooperation. Previously all IFEs were entered into a database and the maintenance department was responsible for fixing the issue. Additionally, departmental semi-craftsmen, previously responsible for solving production-related issues, were assigned to safety tasks, which meant better cooperation between IFE raisers and problem solvers. Information about solved IFE issues was fed back in writing or verbally to shop-floor employees.
2. In the majority of departments, departmental safety representatives were appointed. Volunteers were asked to participate in that initiative. It required them working two days a week only on safety issues. Their work supports compliance with HSE policies on a departmental level. They were responsible for gathering data and maintaining safety-related data bases, writing JSAs, supporting the IFE process (producing

communication, chasing actions) and conducting department-specific audits.

3. A number of shutdowns were performed in response to safety hazards that needed the stopping of work in departments. These actions were communicated to employees.

4. A number of disciplinary actions were conducted on employees who deviated from safety procedures. These were communicated to employees.

5. Critical-four[14] audits were performed jointly by managers, supervisors and often shop-floor employees on a weekly basis. A coaching element was involved to help supervisors and operatives understand why the company is looking at these hazards and get an opportunity to ask questions regarding employees' opinions about safety and specific aspects of safety performance. The graph below shows the overall critical-four compliance scores based on the data gathered during the audits. Numbers on the X axis represent the weeks in a year. The initiative began in the 35th week of 2009 and was still running at the time of writing (September 2010).

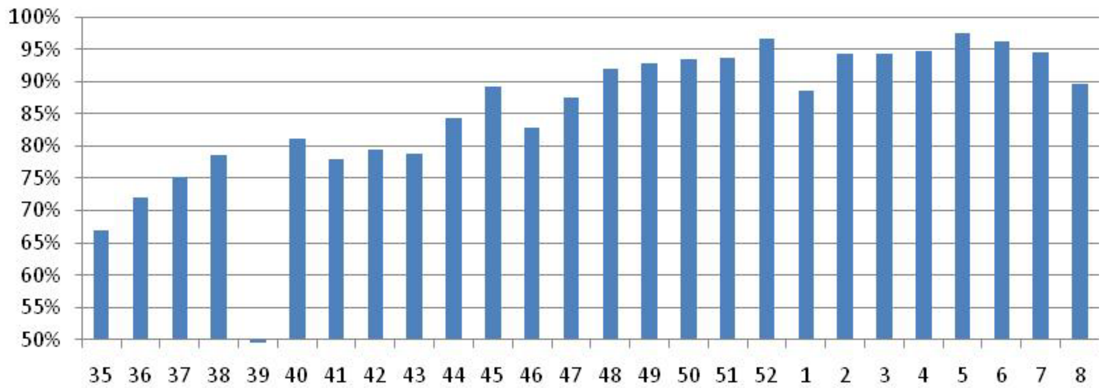


Figure 7. Critical-four compliance scores based on the data gathered during departmental audits.

6. An initiative focused on increasing safety awareness through written and verbal communication about different sets of topics was established.

[14] "Critical-four" refers to four types of danger that cause the largest number of accidents in injuries in the corporation worldwide. They are mobile equipment, log out tag out, fall prevention and confined space.

7. A number of JSAs (Job Safety Assessments)[15] were reviewed with the help and insight of operatives. As a result, working practices were changed.
8. A new senior manager was appointed at the beginning of 2009 responsible for the production and safety of a number of casting plant departments.
9. 5S[16] program was improved and shadow boards[17] were installed in the departments.
10. A manufacturing manager with an IOSH diploma was seconded to the HSE department to support shop-floor safety initiatives when the Health and Safety manager was occupied with coordinating compliance on a legal and policy level. His job was to conduct audits, discuss with operatives, identify hazards and train and coach supervisors and managers.
11. Leaders' standardised work[18] sheets were developed for senior, middle and junior managers, and included safety-related behaviours.
12. All employees were invited to a powerful presentation made by a man who lost his vision in an industrial accident. It enhanced awareness that no person is immune to injuries, and hearing a real person who suffered such severe consequences describe how his life changed after the accident was a powerful emotional experience.
13. In October 2009 the corporate safety director, with the help of the site HR department, organised a safety culture survey. After the survey they organised a number of focus groups with employees from different departments. Their findings were communicated only to the

[15] It is a legal requirement that every job be described in terms of risks and hazards involved as well as counter measures against them. In the company these descriptions are called JSAs.

[16] 5S stands for Sort, Set in Order, Shine, Standardise, Sustain. It is a part of the Visual Workplace program, and in turn comes from the Kaizen system belonging to the Lean manufacturing system, which focuses on the continuous improvement of all elements related to production and effectiveness.

[17] Shadow board is an element of the visual factory programme. Usually it is a large board with painted contours/shapes of tools that should be placed on that board to cover the shadows. It helps the easy visual identification of which tool is missing from the board and thus to maintain order.

[18] Leader-standardised-work is a list of duties developed for particular functional positions based on company priorities and responsibilities of that function. It helps people who use it to structure their day around core tasks and allows the progress they make to be monitored.

group of managers. As it was driven by corporate headquarters, it had a strong impact on leaders' motivation to follow up the suggestions.

14. A number of corporate-driven safety-audits were conducted that resulted in a strong focus by the plant on policies and compliance.

Although at this stage of analysis we cannot definitively claim that attempts to address these components were responsible for the observed change, or which one was the most effective, it may be hypothesised that all these components combined could account for the differences.

6.12. Comparison of 2008-2009 differences within departments

For the departments with more than 20 respondents in 2008 and 2009, t-tests were used to explore changes across the time period. Only four departments fulfilled the condition of having more than 20 respondents in both 2008 and 2009. They were Ceramic Core, Foundry, Large Wax and Small Wax. All other departments could not be compared, as the number of participants either in 2008 or in 2009 was less than 10.

6.12.1. Ceramic core

There were no statistically significant differences between 2008 and 2009 within the ceramic core department.

6.12.2. Foundry

There were statistically significant differences between these two time periods in respect of all four components.

Component 1: 2008 ($M=18.9$, $SE=.8$), 2009 ($M=22.2$, $SE=.9$), $p<.01$, $r=.32$, $t(62)=-2.75$

Component 2: 2008 ($M=16.3$, $SE=.73$), 2009 ($M=20.4$, $SE=.56$), $p<.000$, $r=.46$, $t(61)=-4.073$

Component 3: 2008 ($M=20.1$, $SE=.9$), 2009 ($M=22.8$, $SE=.87$), $p<.05$, $r=.24$, $t(61)=-2.015$

Component 4: 2008 ($M=11.6$, $SE=.54$), 2009 ($M=13.7$, $SE=.7$), $p<.05$, $r=.29$, $t(61)=-2.409$

6.12.3. Large Wax

There were no statistically significant differences between 2008 and 2009 within the large wax department.

6.12.4. Small Wax

There were no statistically significant differences between 2008 and 2009 within the small wax department.

6.12.5. Discussion

We observed some improvement only in the foundry. The results from the safety culture survey itself cannot answer the question about the causes of this change. Again, insight from informal conversations with different employees may be of some use to hypothesise possible reasons.

Except for the initiatives listed above (see Section 6.11.6), there are a number of components that could have affected the foundry department alone:

1. There was a near-death incident in which an operative was accidentally locked in a vacuum chamber and was rescued only minutes before it started working (05.2009). This event emotionally affected the whole company, which brought in a group of investigators from corporate headquarters (05.2009), as well as a corporate business unit auditing safety (05.2009), but most importantly it was a very strong personal experience for employees that their colleague could have died.
2. A safety technician who worked for the Health and Safety department for a number of years was placed full-time in the foundry during organisational restructuring. As he was a highly-respected individual with extensive knowledge and drive to solve safety problems practically, his presence could affect foundry workers' perceptions.
3. There were also comments from operatives and other managers that the foundry manager was very engaged in driving safety improvement.

6.13. General discussion

This chapter attempted to build upon and quantitatively advance the insights afforded by the qualitative study by developing a safety culture questionnaire based on the insights gained during individual interviews and focus groups.

The questionnaire consisted of 30 questions and was distributed on two occasions, in September 2008 and December 2009. Principal Component Analysis was performed, with the aim of establishing the component structure of the company's safety culture. It turned out that the content of the components covered very similar themes as identified in the study discussed in Chapter 5.

Principal Component Analysis conducted on the data gathered from the safety culture survey in 2008 on the total sample of N=293 extracted four components, named: 1. "Interactional leadership", 2. "Solving safety problems", 3. "Breaking rules", 4. "Estrangement".

All of the extracted components appear to reflect parallels with the results of the qualitative study described in Chapter 5. They also appear to be aligned with findings from previous safety culture research. For example, Component 1 "Interactional leadership" is similar to components labelled "management engagement" (Mearns, Flin, et al., 2001; Prussia, et al., 2003) and "Managers behaviour" (Fernandez-Muniz, Montes-Peon, & Vazquez-Ordas (2007). Component 2: "Solving safety problems," is analogous to "Accident prevention measures" (Mearns, Flin, et al., 2001), "Organizational learning with accidents" (Silva, et al., 2004) and "Preventive planning" (Fernandez-Muniz, et al., 2007). The content of Component 3 "Breaking rules" is shared by "Frequency of general unsafe behaviour" (Mearns, et al., 2003) and "Safety Compliance" (Thompson, et al., 1998). Component 4 "Estrangement" is analogous to components developed in the literature like: "Lack of commitment" (Lawrie, et al., 2006), "Satisfaction with safety activities" (Mearns, Whitaker, & Flin, 2001), "Supportive environment" (Cox & Cheyne, 2000) and Relationships (Glendon & Litherland, 2001).

It may be argued that these four components characterise the safety culture of the company. In other words, these are the elements that are mutually distinct in the minds of employees. Therefore improving safety culture should focus on these elements. Additionally, the results of this component analysis tell a lot about the nature of safety in this large company and what is considered important according to the shared perceptions of employees.

There were significant differences between two groups of operators/team leader and groups of supervisors, managers and office positions. The scores of the leaders of office employees were consistently higher/better than those of physical workers or their team leaders. These findings are consistent with other research in the field (Fung, et al., 2005). Although the authors of that study attributed differences to the diversity of education levels between the groups compared, it may be hypothesised, as the items from the questionnaire used in the company refer mostly to the actions of management, that the differences stem from the fact that management tend to perceive their actions as being much more effective than is perceived by the physical workers. Another potential explanation could attribute the differences to the fact that shop-floor workers have everyday contact with hazards and the consequences of unresolved safety problems and these elements affect them directly and emotionally. Support for this conclusion appears to be provided by the results from the focus groups, where people clearly stated that some of the leaders do not interact with them about safety or that postponing the resolution of safety issues causes disaffection and estrangement.

In terms of the differences between departments within the same company with regard to the perception of different safety dimensions, the results lend support to the thesis of safety “sub-cultures” (Weyman & Clarke, 2003) or “multiple climates” (Zohar, 2008) persisting within a single organisation. The departments that took part in the study differed with respect to different components. It may be hypothesised that these differences are the result of particular individuals in managerial positions who prioritise different elements of production and interact with their colleagues in different ways.

Furthermore, the perceptions of different functional positions from 2008 were compared with the same groups in 2009. The t-test statistics revealed that the group of shop-floor employees in 2009 perceived the safety elements related to interactional leadership (Component 1) and solving safety problems (Component 2) more favourably than in 2008. Additionally, a group of supervisors indicated that in 2009, according to their opinion people took risks and broke rules less frequently than in 2008.

There was also an improvement in the perceptions of all four components in the foundry department. These differences may be attributed to a long list of initiatives undertaken by the company in various departments. The full list is included in Section 5.3.6.

6.14. Critical findings

1. The aim of this study was to quantify the findings from the previous qualitative studies and investigate the distribution of components within departments and functional positions in order to inform the development of a safety culture intervention.

2. The principal component analysis based on the data obtained in 2008 yielded four components: leadership, solving safety problems, risk taking, and estrangement.
3. All components referred to exactly the same elements of organisational safety as the themes obtained from the thematic analysis from the qualitative study.
4. In terms of differences between functional positions, the strongest differences were found between operators / team leaders and groups of supervisors, managers and office workers.
5. The notion of safety sub-cultures was confirmed with data showing significant differences between departments within the company.
6. There was an improvement in safety climate in groups of operators and supervisors. This improvement was attributed to a large number of interventions and improvements that were implemented in the company between 2008 and 2009.
7. The foundry was the only department that noticed a significant improvement in all the components of the safety culture questionnaire. The improvement was attributed to a large number of safety improvement programs implemented across the factory and additional resources provided specifically to the foundry to improve its safety record.

Chapter 7

Safety Culture Improvement Intervention no. 1

STUDY 1

7.1. Introduction

Finding ways to enhance compliance with safe practice and reducing volitional risk taking by employees has been a core objective of workplace safety for many decades. Despite major advances in engineering controls that guard or exclude employees from sources of harm, there will always remain elements that are fundamentally behaviourally based, reflecting normative influences that are intuitively malleable.

To date the subject literature in this area has mainly been focused on discovering the definitive set of factors that define and affect workplace safety culture, this having been the primary academic intent. By comparison, relatively few studies have grappled with the challenge of developing interventions aimed at engendering cultural change and enhancement (see Marsh, et al., 1995; Pidgeon, 2001)

According to the meta-analysis conducted by Clarke (2006b), a positive safety climate is significantly correlated with better safety performance. At least one study also reports a weak but statistically significant positive correlation with occupational accidents and injuries (see Horberry, Gunatilaka, & Regan, 2006). Hence, by improving safety culture it is both intuitively and potentially possible to decrease the levels of accidents, ill health and dangerous occurrences.

There is widespread agreement that managerial priorities and leadership style play a key role in defining workplace safety climate, as well as being key variables that affect employee safety behaviour (see for example Barling, et al., 2002; Flin &

Yule, 2004; Kelloway, et al., 2006; Mullen & Kelloway, 2009). The author was unable to find an academic paper challenging that premise. This reflects broader perspectives of organisational culture, that conceptualise this as a derivative of the values and attitudes of senior management (Schein, 2004). Also, the grey literature aimed at Health and Safety professionals is replete with articles indicating the core role of leaders in "defining" employee safety culture (Blair, 2003; Carrillo, 2002, 2005; Geller, 2008; Krause, 2004; Krause, 2007; Williams, 2002).

According to Zohar (2002b), front-line supervisors are the most influential group of employees affecting "group-level safety climate" in an organisation (see Burns, Mearns, & McGeorge, 2006; Cox & Flin, 1998; Fleming, 2001). Having examined the extensive evidence suggesting a strong influence of supervisory behaviours on safety culture in companies (see Chapters 2, 4, 5 and 6), it was decided that there would be merit in devising an intervention that focused on the members of this group.

Based on a review of the literature (see Chapter 2) and insights from previous empirical work at the company (see Chapters 5 and 6), a set of behaviours was identified that supervisors might be encouraged to adopt, which theoretically had the potential to result in the positive enhancement of subordinates' safety performance (see Zohar, 2002b). According to Zohar's multilevel model of behaviour change (Zohar & Luria, 2003), subordinates, in an organisational setting, will tend to align themselves with a superior's expectations towards their behaviour if (s)he pays attention to it. An in-depth description of Zohar's intervention may be found in Chapter 2.

Zohar's intervention was the only – but very effective - study found in the subject literature that focused on modifying supervisory behaviours. For that reason it was decided to apply his methodology as a tool with a proven record of success. In Zohar's study (2003) the application of upwards feedback resulted in a substantial improvement in safety behaviours and safety climate, and it was argued that extending the range of sources of feedback could produce even better results. From the range of tools and techniques reported as promoting transformational leadership (Day, 2000), the 360-degree feedback technique was considered a tool that was on the one hand could feasibly be applied in the company's context, and on the other it was a tool widely used in safety culture improvement intervention (OGP, 2010). The intervention replicated Zohar's approach to behavioural change by applying a multi-level methodology to improve safety climate (Zohar & Luria, 2005). This is the first known replication of that study.

7.2. Method

7.2.1. Negotiating access

A number of meetings with managers and directors were organised in order to discuss their perceptions of the need for change and improvements, their willingness to engage and the availability of resources. At the time of this intervention's preparation the company had two directors; one responsible for the Alloy and Ceramic Core (two separate departments but functioning as one business unit) and a second one responsible for the casting business unit (all other departments). They both volunteered that they would like to implement the proposed interventions within their units and it was agreed to design one intervention for the Alloy/Core business unit (Intervention 1, described in Chapter 7) and one intervention for one of the departments belonging to the casting business unit (Intervention 2, described in Chapter 8). Furthermore, it was agreed that the first intervention would be designed for the Alloy/Core unit. These interventions are discussed in chapters 7 and 8 respectively.

7.2.2. Identifying a department for an intervention

It had to be decided which constituent department to choose. The directors concluded that in the Alloy department there was a higher level of risk, more hazards and in their view, a less positive safety culture, compared to the Ceramic Core department. Their perception was supported by the safety culture survey results (see Appendix E). Hence, it was concluded that the first intervention should take place in the Alloy department.

7.2.3. Experimental and control groups

It was agreed that, in order to demonstrate the effectiveness of the intervention, there needed to be another department with a similar level of hazards involved in which the same outcome measures could be applied but without an intervention, to act as a control group. The only department at the site that performed analogous jobs was the Foundry department. The management of the casting unit agreed to involve the Foundry in the study as a control group. According to the in-house safety experts (N=4), the level of risk and variety of hazards were comparable in both departments in terms of noise, exposure to molten / hot metal, machinery, fork-lift trucks, manual handling, exposure to infra-red radiation, man-made mineral fibre, dust, oil mist, slips, trips, arc flash, electricity, overhead cranes and falling objects. Moreover, both departments worked 24/7 and there were similar numbers of people working in a shift at any one time (about 10-15).

The alloy production department produces alloy bars. The department has areas for storing chemicals, large furnaces to melt the metal, lines for the treatment of the bars, storage area for bars, an area for processing scrap and a yard for loading and unloading the products from lorries. At the time of planning the intervention the department was employing 84 people in total, including shop-floor, office support, chemical laboratory and management staff. 61 people were working on the shop-floor including maintenance.

The foundry department is responsible for casting the parts by pouring hot, liquid metal into previously prepared forms. Within the department a number of large, multi-level[19] furnaces are placed, as well as storage areas for the products. The castings are moved with fork-lift trucks. At the time of planning the intervention the department was employing 78 people, of which 73 were working on the shop-floor.

Operations in both departments included melting super-alloys from pre-determined formulae or pre-made billets under vacuum and pouring them into billet moulds or more intricate moulds for parts. The Alloy furnaces were larger and casting up to 15 tons per pour, whereas the foundry operations cast up to 100 kilograms at a time. The Alloy cycle time is longer - up to 8 hours per melt - whereas foundry cast cycles can be between 10 and 30 minutes. Foundry directional solidification (DS) casting furnaces also operate at the higher end of the operational temperature scale, casting at temperatures above 1500°C and are cooled by internal water lines. Any uncontrolled failure of these machines could be catastrophic. The casting foundry is less than 1/3 the size of the Alloy plant and also utilises gas-fired pre-heat furnaces operating at between 1050 and 1200°C.

Many jobs in both departments involved operating heavy machinery, including furnaces, large over-head cranes, heavy hand-tools, driving mobile equipment, as well as conducting simple tasks such as housekeeping. Employees were exposed to red-hot

[19] It means that a furnace is being operated from the ground and from the platforms about two and three meters above the floor.

molten metal, and the infra-red radiation associated with it, while moving the pieces from one place to another. With regard to management structure, there were supervisors responsible for the shifts. The role of the supervisors was bridging the groups of shop-floor employees and a group of managers. On the one hand foremen had to plan the job, assign the tasks, supervise the performance, look after their team and manage morale and motivation; on the other, they had to satisfy the expectations of managers and report work progress on regular basis.

The Human Resources department strongly suggested that the researcher should not gather demographic information about the participants of Intervention One, expressing concerns that the personal data could not be protected as expected by law (Data Protection Act 1998). The only information that could be provided about the two groups (experimental and control) is that all participants were male and between 30-60 years old. The majority of them worked for the sponsor company for more than 5 years. They worked in their departments for the majority of this time. Their work required a fair amount of communication and cooperation. As the group of managers and supervisors was very small, all information about these individuals could lead to their identification and for this reason was not included.

7.3. Design

7.3.1. Intervention design

Based on the unprecedented success of Zohar & Luria's intervention (2003) and strong empirical evidence supporting the theory behind his claims, it is argued that Zohar's model for the improvement in safety climate may be the best theoretical model available. Zohar's method aimed to involve managers and supervisors in the intervention, and use them to affect the behaviour of the shop-floor employees. This matched closely one aspect of the safety culture of the sponsor company – leadership. The literature consistently suggests that leadership engagement is the most important factor shaping safety culture, and it was decided to increase the impact of the intervention by addressing this particular group with a method that was proven to be effective. In general, at the time of designing the intervention, the researcher had two options: either try to develop a novel, untested mechanism for change, or use (and enhance) the mechanism with already reported strong results. The question the researcher faced was: what had the higher probability of success? At the time of design, before the implementation, the answer seemed clear that more value could be brought to the company by implementing a programme that has already proved its efficiency. Therefore it can be argued that the choice of the intervention was bespoke, as it targeted a variable identified in the literature and earlier investigation in the company as very important. Studies researching the effectiveness of multi-source feedback on performance usually apply surveys or questionnaires to gather data (Atwater, Waldman, Atwater, & Cartier, 2000). However, the majority of studies take feedback information only once, prepare a report with the results and provide it to the person(s) being assessed (Seifert, Yukl, & McDonald, 2003). However, as Zohar & Luria (2003) demonstrated, a single feedback session is not effective. Only feeding back the important information for a long period of time (10 months) brought the desired outcome. Therefore it was decided to provide feedback to supervisors and managers on a regular basis for the whole period of the intervention.

The researcher's intervention assumed the involvement of all levels of hierarchy to ensure the flow of expectations from the top. The main goal of the intervention was to improve the quality of safety-related interactions between supervisors and shop-floor operators in accordance with Zohar's theory. In order to support the behavioural change of supervisors, the line manager must be engaged in the process. This engagement demanded timely, regular communication about the expectations towards new behaviours of supervisors.

In order to help supervisors and managers develop their new skills, they were provided with multi-source feedback. The group of supervisors obtained feedback from operators, peers and managers and the group of managers obtained feedback from operators and supervisors. At this stage the researcher was involved in gathering feedback and calculating the summative results. The summated feedback was then delivered on a weekly basis to the group of supervisors and managers.

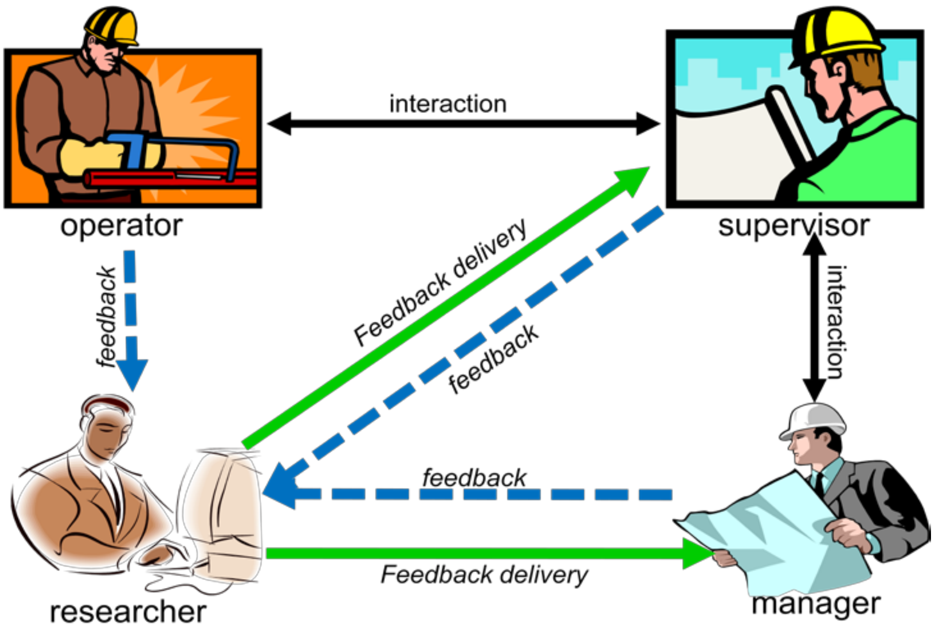


Figure 8. A graphical representation of the feedback-based safety improvement intervention.

7.3.2. Background

Based on the multi-level leadership theory (Zohar, 2002b; Zohar & Luria, 2003), Zohar developed a safety intervention that involved supervisors and managers in order to improve the safety-related behaviours of operatives. In his intervention each supervisor received bi-weekly, personalised, upward feedback based on summated frequencies of safety-related interactions obtained from operatives with the help of short questionnaires. Each manager was provided with comparative information about all supervisors reporting to them and was asked to inform every supervisor about his relative position compared to other supervisors on a bi-weekly basis. Managers were also asked to discuss with supervisors the reasons behind success or failure, identify facilitators and inhibitors and set improvement goals for the subsequent two weeks. Senior managers received cumulative information about the progress of the intervention during scheduled meetings. The intervention was announced by the plant manager and lasted three months. Participation was voluntary and only 4% or less of operatives declined to take part in the study.

Zohar’s intervention was implemented in two different companies: oil refinery and canning and distribution. Safe behaviours were operationalised in the first company as compliance with electrical procedures and moving within access zones without crossing designated paths, and in the second company as the use of protective gear and housekeeping. The intervention resulted in a steady increase of safety-related supervisory interactions, rising in the first company from 35% to 50% at the end of the intervention and to 70% by the end of the 41st week. In the second company the intervention resulted in the rise of supervisory interventions from 225% to 40% and to 65% by the end the 41st week. These changes suggest the modification of the supervisory role definition. In terms of unsafe behaviours, they dropped in the first company by 20% and in the second company by 30% by the end of the intervention, and kept dropping to almost 0% at the end of the last week of the follow-up. Significant changes in safety climate were discovered as a result of the implementation of the intervention.

7.4. Measures

In order to evaluate the intervention a number of measures were applied. At first, as the intervention aimed to influence safety culture, a questionnaire-based safety climate measure was chosen (Zohar, 2003) to establish the current state of this variable before the implementation of the intervention. Also, other related measures were chosen based on the literature review: leader-member exchange (LMX), job security and safety citizenship, as these were widely cited as having potential to affect employee workplace safety perceptions.

In order to evaluate the effect of the intervention on safety behaviours and shop-floor performance, an observation checklist focussing on the behaviours of operatives and their consequences was developed (see Section 2.4.5 and the Appendix E). Finally, in order to implement the intervention, a 360-degree feedback tool was designed that focused on supervisory and managerial behaviours. All of these methods will be described in the following sections. All methods are attached in Appendix E. All the developed and applied measures will now be described and justification for their use provided. Coefficient alphas for each scale for the present sample are shown in Table 29.

Table 29. *Coefficient alphas for all used scales for the present sample*

Scale	Coefficient alpha
Zohar group level safety climate	0.92
Zohar Organisational level safety climate	0.91
Safety citizenship behaviour	0.95
Leader – Member Exchange	0.86
Job insecurity	0.90

7.4.1. Measure 1 – Safety Climate

As Zohar's multi-level model of behavioural change was used for the study, utilising his safety climate questionnaire was preferred to alternatives including the questionnaire developed as part of this thesis. The rationale was that the Zohar's measure consists of items and scales focused solely on supervisory behaviours. Therefore it was felt that Zohar's method will provide more precise measure of change than other, more generic tools. Moreover, Zohar's factorial structure has been confirmed by Johnson (2007). This measure was also used in the study conducted by Cooper & Philips (2004), who empirically established a limited link between safety climate and safe behaviours. It was also used in a study by Luria & Rafiaeli (2008).

Zohar's measure consists of two parts (see Chapter 2). The first part refers to organisational-level safety climate (perceptions of top management's engagement with safety) and the second one to group-level safety climate (perceptions of supervisory engagement with safety).

His organisational-level safety climate scale consists of 16 statements referenced to a 5-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). He reports basing the items for this scale on the British Standards Institute's (2000) safety management code, which is compatible with ISO-9001 and ISO-14001 for quality and environmental management systems. The internal consistency reliability Alpha of this scale is 0.92 (Zohar & Luria, 2003).

His group-level safety climate scale also consists of 16 statements accompanied by a 5-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). Statements here refer to safety-related interactions between supervisors and operatives. The internal consistency Alpha of this scale is 0.95.

7.4.2. Measure 2 – Safety Citizenship Behaviour

Role definition refers to Graen's (1976) theory of role making processes within complex organisations. He argued that employees develop a sense of their role based on their perception of what they are supposed to do, what they prefer to do and what they know how to do. This subjective understanding of job responsibilities is held to influence the behaviour exhibited by employees. As Morrison (1994) noted in commenting on the research of Graen (1976) and Salancik & Pfeffer (1978), subjective role definition is socially constructed rather than objectively defined.

Proponents of the theory hold that within the scope of a company's expectations towards employees, there are formally described behaviours, as well as behaviours that are not formally defined. The latter type of behaviours is called Organisational Citizenship Behaviour (OBC). OBC is credited to Organ and refers to *"individual behaviour that is discretionary, not directly or explicitly recognized by the formal reward system, and that in aggregate promotes the effective functioning of the organization"* (1988, p. 4).

OCB is an important concept because, according to Hofmann, Gerras & Morgeson (2003), citizenship role definition is significantly related to citizenship behaviour. Clarke (2006), referring to Gouldner's (1960) theory of social exchange, emphasises that OCBs are promoted through the norm of reciprocity, whereby employees feel obliged to return favours in the light of positive treatment from others. Similarly, Organ (1990) observes that employees use OCB as a form of reciprocation for being treated fairly. The better the quality of the exchange relationship with the supervisor, the more likely it is that the employee will perform OCB. The employee uses OCB as a medium of exchange with the organisation (Lam, Hui, & Law, 1999). Morrison (1994) showed that an important driver of employees' behaviour is their perception of whether a given activity is in-role or extra-role. It is held that if an employee defines an OCB as in-role, they are more likely to perform it, than if they define it as extra-role (Morrison, 1994).

Role definition can contain safety elements. Safety role definition refers to what employees perceive as their own responsibilities with respect to improving safety for themselves and their co-workers (Turner, Walls, & Chmiel, 2005). The scope of safety-related duties included in formal descriptions of employee job roles tends to be limited, due to the nature of the work on the shop floor. Elements such as reporting minor injuries, near-misses or other forms of safety participation, which allow the organisation to learn and prevent accidents, involve a strong voluntary element, including behaviour beyond the employee's formal role (i.e. OCBs) (Clarke, 2006a) and are subject to cultural normative influences. Hence, in order to increase the rate of workers' OCBs, it is necessary to create an environment where safety becomes included in their definition of in-role. The theory holds that OCB behaviours on the part of supervisors will engender reciprocal motivations amongst shop-floor employees, with benefits in terms of organisational learning with respect to hazard control performance and employee compliance with safe practice.

There are specified conditions that enhance the likelihood of safety OCBs emerging. Turner et al. (2005) showed that employees who perceived higher job demands were less likely to consider safety as part of their role. At the same time, employees with high perceived job control were more likely than employees with low perceived job control to consider safety as part of their role. This result is attributed to Karasek's strain effect (1979), who demonstrated that a high-demand and low-control workplace substantially limits workers' ability to solve problems or tackle challenges and contributes to the feelings of depression. Hofmann et al., (2003) demonstrated that employees will manifest OCBs related to safety only if there is a mature safety climate. In such instances a strong cultural emphasis on safety climate is said to create space for reciprocal behaviours. However, in a context in which there is a high level of LMX against a backdrop of a negative safety climate, OCBs are less likely to extend to the safety agenda naturally (Hofmann, et al., 2003).

The "safety citizenship behaviour" tool (Hofmann, et al., 2003) was based on other measures of organisational citizenship behaviour (Van Dyne, Cummings, & McLean-Parks, 1995; Van Dyne, Graham, & Dienesch, 1994; Van Dyne & LePine, 1998). It consists of 27 statements reflecting safety-related helping, expressing recommendations and opinions, stewardship and whistle-blowing referenced to a 5-point rating scale with anchors of: Expected part of my job, slightly beyond what is expected for my job, moderately beyond what is expected for my job, much beyond what is expected for my job and definitely beyond what is expected for my job. The internal consistency reliability Alpha for this scale is reported as 0.98 (Hofmann, et al., 2003).

The tool appears to have been used in the context of workplace safety research on at least two occasions. Turner, et al. (2005), for example, report that employees with a perceived high job demand were less likely to include safety in their role. Additionally, Didla, Mearns, & Flin (2009) report the finding that safety culture is an important factor affecting safety citizenship behaviours.

7.4.3. Measure 3 – Leader-Member Exchange

It has been established (see Chapter 2) that leadership is widely held to be the most influential variable affecting employee safety culture. Therefore, the control of this dimension not only seems to make a lot of sense, but is very important indeed.

In their review of leadership, Graen & Uhlbien (1995) concluded that the evidence could be grouped into three domains: leader, follower and relationship. “Leader” is cast as relating to the mix of personal traits, behaviours and characteristics of supervisors and managers. “Follower” – is cast as relating to the same elements, but for blue-collar workers. “Relationship” emphasises the ideal combination of the properties of leaders and followers to promote the desired outcome.

Zohar (2002b) reports that safety culture may be improved by increasing the frequency and quality of interactions between supervisors and operatives. His results suggest that, by improving the relationship between leaders and followers, the safety culture may be advanced. Based on these arguments, the choice of a method focused on the quality of the relationship seemed to be justified.

Leader-Member Exchange (LMX) has a long research tradition. It has been studied with reference to variables such as job performance (Dunegan, Duchon, & Uhlbien, 1992), staff turnover (Vecchio, Griffeth, & Hom, 1986), job satisfaction (Perrewe, Brymer, Stepina, & Hassell, 1991), organisational commitment (Nystrom, 1990), organizational citizenship behaviour (Podsakoff, MacKenzie, & Hui, 1993), job climate (Kozlowski & Doherty, 1989) and safety (Hofmann & Morgeson, 1999; Hofmann, et al., 2003). In each case LMX is reported to be positively correlated with performance.

Hofmann and Morgeson (1999) provide evidence that high-quality interactions between leaders and operatives improve safety-related communication, are related to safety commitment and are negatively related to the frequency of accidents.

Hofmann, et al. (2003) also demonstrated a positive relationship between LMX and safety citizenship role definitions, reporting that this relationship was moderated by safety climate and that both the LMX and safety citizenship were significantly related to safety behaviour.

Following a testing of available measures, Graen & Uhlbien (1995) concluded that a seven-item scale was sufficient to capture the profile of LMX (Gerstner & Day, 1997). The list of statements may be found in Appendix E. The scale asks participants to indicate the extent of their agreement with seven statements about their relationships with supervisors, referenced to a 5-point scale, using Likert-type anchors ranging from 1 (strongly disagree) to 5 (strongly agree), where higher scores indicated the better quality of relations. Scale scores are created by calculating the mean across the seven items for each individual combined for all respondents to obtain an overall construct score. Graen & Uhlbien (1995) report an internal consistency reliability Alpha of 0.94. The method was used by Michael, Guo, Wiedenbeck, & Ray (2006) who reported a positive relationship between LMX and safety-related behaviours. Similarly Kath, Marks, & Ranney (2010) report a link between LMX and the quality of upward safety communication.

7.4.4. Measure 4 – Job Insecurity

The intervention study took place during the early phase of the world-wide financial crisis that began in 2007. As a consequence of the declining demand for its products the company began a process of downsizing, with enforced redundancies commencing in early 2008. In view of this, it was decided that it would be prudent to add a measure of employee perceptions of job insecurity to the body of evidence gathered. Increased job insecurity has been widely cited as having a negative impact on safety standards. Cited negative effects include reduced safety motivation and compliance with safety rules; and a focus on production (Probst & Brubaker, 2001).

However, these authors conclude that a positive safety climate can attenuate the negative effects of job insecurity.

The Job Security Index developed by Probst (2003) measures an individual's cognitive appraisal of the future of their job with regard to the perception of the level of stability of that job. It comprises a series of adjectives that describe the future of the employee's job. Respondents are asked to rate how well the adjective describes the future of their job, referenced to a 3-point scale, with anchors of "yes", "neutral" and "no". This type of response format was chosen as previous research findings indicate that it is easy for employees with a low level of literacy to understand and discriminate between categories (Roznowski, 1989). Probst reports an internal consistency Alpha of 0.97 (Probst, 2003).

7.4.5. Measure 5 – Behavioural audit

The behavioural audit would permit the generation of baseline and monitoring data on shop-floor safety standards. The behavioural audit measure was developed by the author, based on established behavioural safety measurement principles (Marsh, 2005). All behavioural audit data were collected between 3 and 5 times a week by the researcher. The method and data gathered replicate those reported in Marsh, et al.(1995). The checklist of unsafe behaviours and indicators of unsafe behaviours (antecedents) was used to calculate the safety performance level (see Appendix E).

The development of the behaviour-based observation measures was based on the following:

1. Discussions with shop-floor workers, supervisors and managers about what, in their opinion were the most important hazards / risks and risk behaviours.
2. A review of safety policies and audit tools used by the company locally and worldwide.
3. A list of desired behaviours, compliant with safety standards and policies, was created.
4. A special form was prepared to allow data gathering. Observation of each item could be marked as safe (if a person complies with the content of an item), unsafe (if a person does not comply with the content of an item) or not applicable. The full form may be found in Appendix E.
5. The behavioural checklist was piloted to confirm that all items were observable. The behavioural checklist consisted of a list of behaviours (e.g. using a ladder unsafely) or consequences of unsafe behaviours (e.g. trip hazard on the walkway). The piloting aimed to check whether all the items were easily observable. If the checklist contained behaviours that were very rare or were very difficult to observe, there would be no use of these items. The researcher visited the investigated departments five times and went through the list item by item. The piloting activities confirmed that all items on the list are easily observable and no item was removed from the list. As the checklist was not a tool for a psychological measurement, no psychometric properties were calculated.

7.4.6. Measure 6 - Feedback forms

Feedback is a popular tool within the organisational change domain as well as safety. It has an established history as a tool for engendering behavioural change in the workplace safety arena, but has tended to be focused on employees, rather than on managerial behaviours. Saari & Nasanen (1989), for example, provided graphical feedback to shipyard employees with regard to their housekeeping performance, claiming and accident reduction rate between 70% and 90%. Similar results are claimed by Leivo (2005), who provided graphical feedback to road maintenance personnel about the level of housekeeping. Additionally, Williams and Geller (2000) noted a significant improvement in safety performance after an intervention involving feedback based on behavioural observations. However, a word of caution is necessary here. These studies provided feedback to shop-floor employees based on observations conducted by an independent observer/contractor/researcher. The feedback was not personalised and presented aggregated results for groups, not individuals. This is an important detail as performance was not linked to particular individuals, so the responsibility for performance was spread equally among team members. Moreover, the afore mentioned interventions provided feedback based on observed performance and not based on how individuals are being perceived by their colleagues. Therefore the type of feedback in the interventions cited above is different to 360-degree feedback. The real cause of these improvements is also in question as a qualitative study conducted after a similar intervention (Marsh, et al., 1995) demonstrated that the participants of a feedback-type intervention were not paying attention to the content of the feedback and did not have knowledge about feedback information but improvements were noticed despite that fact.

Criticisms of feedback-orientated behavioural-based interventions focused on employees alone centre around the premise that they seek to treat the symptoms (employee behaviour) rather than the cause (managerial behaviour) (Zohar, 2002b). In advancing their theory of multilevel leadership, Zohar & Luria (2003) caution against schemes in which reinforcement is only targeted at workers, as it is partial, insufficient and does not focus on addressing deeper causal influences, particularly the normative role played by immediate superiors. Zohar argues that within an organisational context it is a role of effective supervisors to provide training/coaching (antecedents), goal setting and feedback, and incentives such as personal attention and recognition (consequences) to operatives in order to modify their behaviours. The supervisory level must be supported by the third level – managers who have to communicate safety priorities even under work pressure. The multi-level concept refers to the process in which behaviours of employees at a lower level of hierarchy are modified by the leaders at a higher level of organisational hierarchy. In their study, Zohar & Luria (2003) delivered feedback to supervisors and managers from blue-collar workers in order to change their behaviour. The feedback came from only one source. However, there is some evidence suggesting that involving more sources in the feedback process may bring better results (Atwater & Waldman, 1998). 360-degree feedback refers to a method of gathering perceptions about an individual's performance from all stakeholders – superiors, peers and subordinates (Warech, Smither, Reilly, Millsap, & Reilly, 1998). The claimed advantages of the approach to managerial performance assessment are that it offers a more complete picture of managerial performance than traditional linear forms of assessment (Atwater & Yammarino, 1997).

However, a 360-degree feedback tool has limitations that must be highlighted. While there are widespread claims of its effectiveness Kluger & DeNisi (1996) demonstrated that 360-degree feedback resulted in a decrease in performance in one third of the interventions that they reviewed. It has been suggested that one of the reasons is that people have psychological defence mechanisms that protect them from information perceived as threatening (Chappelow, 1998). These findings are supported by Atwater, et al. (2000) who claim that only 50% of interventions that used multi-source feedback resulted in improvements. Despite these threats, 360-degree feedback is now widely used in the leadership development arena, having been described as "perhaps the most notable management innovation of the 1990s" (Atwater & Waldman, 1998). London & Smither (1995) report that this technique is used by nearly all the Fortune 500 companies.

Based on a combination of the literature insight (Zohar, 2000) and employees' comments obtained during informal discussions feedback forms (see Appendix E) were prepared to provide information:

1. From operatives to supervisors
2. From operatives to managers
3. From supervisors to managers
4. From supervisors to supervisors
5. From managers to supervisors

During the informal discussion with supervisors and operatives, it became apparent that they valued the extent of freedom and flexible supervision, i.e. operatives were highly skilled and did not need permanent supervision and checking. Moreover, supervisors were working physically on the shop floor and could not spend the majority of their time on supervision. Therefore it was important to increase the frequency and quality of safety-related interactions while still leaving room for the subjective perception of operatives of the intensity of the interactions with their supervisors. Therefore, instead of focusing on counting the numbers of interactions, it was decided to focus on the subjective perception of its intensity. Thus, participants were asked to indicate their response on a six-point, Likert-type scale where 1=Never, 2=Rarely, 3=Occasionally, 4=Sometimes, 5=Fairly often, 6=Very often.

7.5. Procedure

Before the intervention began, a meeting with managers, supervisors and all operatives was organised in order to discuss the proposed intervention. The researcher introduced the idea of the intervention; the managers expressed their support for the initiative and operatives were asked about their opinion and potential issues they saw. Operatives asked a few questions to clarify the idea but no objection was raised. Additionally, written communication in the form of a poster with questions and answers regarding the intervention was put on the departmental notice board.

It was agreed that observations of (un)safe behaviours would be conducted 3-5 times a week between 2 and 5pm. The choice of time was important, as the pace of production changed during the day: it was higher in the morning and slower in the afternoon. Conducting observations consistently in the same time period minimised the influence of the production pace's variation on the results of the observation. In order to establish the baseline of safety performance before the intervention began, observations were conducted for four weeks.

It was agreed that feedback would be delivered to supervisors and a manager once a week on Fridays in a summated form. One day was needed to calculate the results and prepare the reports so Wednesday was chosen to gather feedback from available operatives and supervisors. Operatives were given an extra 10 minutes' time after their regular break to stay in the break room to fill out the feedback forms. The participation in the intervention was voluntary.

7.6. Results

In Week 1, 17 operatives (3 from the morning shift and 14 from the afternoon shift) filled out the feedback forms. In Week 2, some operatives expressed the fact that they did not feel comfortable with completing the forms and would prefer to avoid doing it. They were reminded that we agreed on the procedures before the intervention started. This time 10 people filled out the forms, but only from the afternoon shift. However, they raised the concern that they were afraid of being recognized or identified, as the researcher was collecting the forms in person. To address this issue, a sealed box was provided in a break room. In the third week no person filled out the form. Also, operatives refused to comment on their decision. They did not take the opportunity to extend their break , and did not explain to the researcher their reasons for the refusal.

As gathering feedback was a core activity on which the intervention was based, the lack of information about supervisory and managerial behaviours threatened the continuation of the initiative. As no information could be delivered to supervisors and managers about the perceptions of their interactions with operatives, it was decided to stop the intervention and attempt to understand the reasons behind its failure (see Chapter 7, Study 2). No post-test measure could be administered due to strong resistance of employees to cooperate with the researcher.

7.7. Discussion

Despite the best effort made to reduce the potential of failure of the intervention, the operatives refused to participate in the program after the second week. Reflecting back on the process of the implementation, it is clear that a number of actions were undertaken in order to nest the intervention within the department. In the light of practitioners' advice (Edwards & Even, 1996; Ward, 2006), many of the crucial points for success were applied: the purpose of the intervention was communicated to the management and other employees, it appeared that they engaged in the process, the process was piloted and validated, the confidentiality of the answers was guaranteed, the process of filling out the questionnaires was simple, feedback was provided in a timely manner and both supervisors and operatives were granted extra time off the shop floor to participate in the program. However, it is possible that not all elements were addressed.

The main focus during the negotiations was on winning the buy-in from the managers, as according to Zohar & Luria (2003) they are responsible for engaging operatives. At the time of the intervention's development it appeared that the researcher should cooperate with operatives to a minimal extent, as the management would work on winning their hearts. Also, it is possible that, although the purpose and stages of the strategy were communicated, the information was not detailed enough.

Moreover, the supervisors were not trained in demonstrating new behaviours, which could be another flaw of the design that affected the process of implementation.

However, in most cases, when discussing the reasons for failure of the feedback programs, it is argued that the most vulnerable group is the group of receivers of feedback, as they struggle the most (Smith & Fortunato, 2008). Conversely, in the case of this intervention, the group that resisted the process was the group of feedback providers, not the receivers and maybe the direction of feedback was an important variable affecting employees' motivation to participate in the study.

Atwater, Brett, & Charles (2007) discuss some factors related less to the feedback receivers and more to the process of implementation. They suggest that the level of trust, cynicism and integration of the intervention with other activities and the perceived need for change may affect the success of an intervention.

Another possibility is that the type of intervention was not appropriate for the current level of safety culture maturity of the organisation. According to the report prepared by the International Association of Oil & Gas Producers (OGP, 2010), interventions based on feedback should not be applied in organisations that are at pathological and reactive levels of safety culture maturity, because the level of trust at these levels is too low and employees may undermine the intervention, perceiving it as a threat.

Despite the fact that a number of potential reasons may be provided, without an in-depth investigation into the operatives' subjective perceptions and other variables, they would only be speculation. Therefore it was decided to explore the reasons for failure in order to understand what happened, and whether the reasons are predicted by the existing literature. Two series of interviews were conducted: one with the operatives who took part in the intervention and the second one with a safety professional whose profession is the implementation of similar programs. The process and results are described in the next section.

7.8. Critical findings

1. Based on the literature review (see Chapter 2), the focus groups (see Chapter 5) and the safety culture questionnaire developed (see Chapter 6), it was concluded that an intervention focused on the behaviours of supervisors and their superiors may be the most powerful (see Zohar & Luria, 2003).

2. A before-and-after test with an experimental group design was chosen as the most appropriate for the assessment of the effects of an intervention.
3. The alloy department was chosen as an experimental group and the foundry department as a control group.
4. Six measures were identified to gauge the effects of the intervention: multi-level safety climate, leader-member exchange (LMX), safety citizenship, job security, behavioural observation checklist and the 360-degree feedback tool.
5. The baseline before the beginning was established with the available measures.
6. Information about supervisory and managerial behaviours began to be gathered from the blue-collar employees and supervisors with the use of the 360-degree feedback tool and was then delivered to the group of supervisors and managers.
7. After the second week of the intervention the shop-floor employees declined to provide further feedback and, as the feedback was the conceptual core of the intervention, the initiative had to be stopped.
8. It was decided to investigate the reasons and motives behind the resistance. The results of that research are provided in the Study 2 (see Chapter 7, Study 2).

STUDY 2

7.9. Introduction

Although the intervention described in Study 1 (see Chapter 7, Study 1) was very similar, in terms of the process, to Zohar's very successful study, it failed to maintain the employees' engagement, which was the base of the intervention. The subject literature offers a number of recognised sources of disruption of the implementation of feedback programs, but none of them relates to a safety intervention. Although the insight from the scientific articles is useful and inspiring, it is conceptually disconnected from the type of intervention implemented in the company. Even if a list of barriers obstructing the success of safety interventions was provided, it still probably would not provide the exact set of reasons that affected the employees in this particular study.

The intervention designed for this thesis had a very positive beginning, with strong engagement of managers, but with a very abrupt ending. It was worrying that the application of most of the suggestions available in the literature produced such an unsuccessful outcome. The discussion in the Study 1 of this chapter attempted to offer some variables already recognised by the literature as threatening to feedback-based interventions. However, without an in-depth exploration, they remain mere suggestions and hypotheses. This is why it was decided to conduct a number of interviews with the participants of the intervention, hoping they could shed some light on the reasons that caused their resistance. However, it was decided to broaden the perspective and also engage a group of experts, since as shown by the failure of the intervention, it was apparent that the subject literature omitted some variables that affect the success of the implementation of safety-related interventions. The methodology and results will be described for both groups of interviewees (participants and experts) subsequently, and a summarising discussion for all findings of this chapter will be provided at the end.

INTERVIEWS WITH THE INTERVENTION PARTICIPANTS

7.10. Method

7.10.1. Participants

Four people, with whom the researcher had the best relationship based on personal trust (operatives N=2 and supervisors N=2), were asked to participate in the interviews. The trust issue was crucial here as it was predicted to determine openness and honesty during the interviews. Interviewees were asked for permission to be voice recorded. It was explained to them that this process may be of great assistance to the researcher and his studies. One person did not agree to be voice recorded but allowed the researcher to take notes, but without exact quotations.

7.10.2. Materials

The main purpose of the interviews with the intervention participants was to understand their subjective perceptions of the whole process and the reasons behind their resistance. Therefore prompts were developed based on the history of the implementation process to investigate the cognitive and emotional elements driving the behaviour of employees. The full set of prompts may be found in Appendix E.

7.10.3. Procedure

Individuals were informally approached during their break and invited to talk to the researcher in one of the conference rooms face to face. The management granted permission for employees to take the time off the shop floor. The data were transcribed verbatim from a voice recorder to a computer text editor.

It was decided to apply thematic analysis to the data set. The description of the method and the detailed reasons for its application were provided in Chapter 5. The process of analysis was analogous to the one conducted in Chapter 5 for the analysis of focus group transcripts and had a number of stages:

1. All transcripts were coded in full by the researcher. The table below shows a full list of codes developed and used during the coding process.

Table 30. *A list of codes that emerged from the initial coding process*

Fear of being identified	No trust towards management
Fear of using info against operatives	Not a part of job
Perception of duties	Lack of trust towards the researcher
Transparency of intervention	No trust towards researcher
Face validity	Negative past experiences
Transparency of the intervention	Communication of the intervention
Perception - Intervention as a threat for relationships	Couldn't take more information on
No perceived benefit for operatives	Negative perception of management
Alienation/disaffection	

2. The codes that were the same or similar were collated together jointly with the text excerpts they were describing. It allowed the creation of nine categories/themes. The table below shows how codes were categorised and how the groups were titled.

Table 31. *The initial codes grouped in categories*

Names of categories/themes	Initial codes collated according to the topic they cover
Trust towards management	Fear of being identified No trust towards management Fear of using info against operatives Perception - Intervention as a threat for relationships
Role definition	Perception of duties Not a part of job
Transparency of communication of the intervention	Transparency of intervention Transparency of the intervention Communication of the intervention
Face validity	Face validity
Alienation	Alienation/disaffection
Trust towards the researcher	Lack of trust toward the researcher No trust towards researcher
Other	No perceived benefit for operatives Couldn't take more information on Negative perception of management

3. In the category "Trust towards management," two sub-categories were distinguished: a) fear of being identified and b) fear of using information against operatives.

7.11. Results

TRUST TOWARDS MANAGEMENT

Trust issues have already been identified in the literature as one of the crucial concepts affecting coherent cooperation between management and subordinates. Trust is a mechanism used by managers to create openness and honesty and, ultimately, a better efficiency of a workgroup (Mollering, Bachmann, & Lee, 2004). Trust towards top management affects work satisfaction (Perry & Mankin, 2007), commitment to the team (de Gilder, 2003) and performance (Mayer & Gavin, 2005). In the field of safety it has also been recognised that trust plays an important role. Burns, Mearns, & McGeorge (2006) argued that trust plays a crucial role in safety culture. Jeffcott, Pidgeon, Weyman, & Walls (2006) and Conchie, Donald, & Taylor (2006) suggested that trust is an important characteristic of safety performance. It has even been argued that safety-specific trust is a separate construct, distinct from other types of organisational trust (Conchie & Donald, 2008), and that it moderates the relationship between safety-specific leadership and safety citizenship behaviour by increasing subordinates' willingness to follow supervisory influences (Conchie & Donald, 2009).

Despite the fairly deep understanding of the role of trust and its effect on safety-related activities not much attention has been given to the role of trust in safety improvement interventions. Some indicators that the level of trust towards management may affect the success of organisational change programs may be found in practitioners journals (Barrier, 1998; Gerald, 1994; Phillips, 2003), but they are based on the knowledge and experience of practitioners and not on research findings. A recent study of Neves and Caetano (2009) showed that trust mediates the impact of affective commitment to change and continuance commitment to change on performance, organisational citizenship behaviours and turnover intentions, but the insight was not related to safety interventions.

The intervention participants in the alloy department indicated that trust towards management was one of the factors that affected their engagement. However, it appeared to have two distinguishable sub-categories. It was: a) fear of being identified, and b) fear of information being used against individuals.

a) Trust towards management – fear of being identified.

Shop-floor workers stated that the resistance was partially caused by the fear that the information they provided would lead to the identification of individuals.

Although before the intervention an effort had been made to explain that they could not be identified based on their answers and that data would be provided to the management only in the form of collated charts, it remained an issue. These opinions were expressed in the following way:

"I was afraid of being identified based on the forms we filled out"; "I was concerned that the management would get access to the information I provided".

b) Trust towards management – fear of information being used against individuals.

Fear of being identified was supported with the concern of being somehow punished for revealing information about interactions between workers and supervisors. Operatives thought that workers and supervisors could be affected.

"We were suspicious that this may be used against us"; "We were afraid that information we provide could be used against our supervisors".

Two examples provided that could explain this attitude were negative experiences from the past regarding providing information about workers. The researcher was told a story in which the company overreacted to a piece of information and disciplined somebody, although it was felt by other employees, that others had not been disciplined for similar things in the past. Another contextual variable was the fact that the intervention started when the global financial crisis was in full swing, making the threat of redundancies very real. Therefore they did not want to risk revealing any information that could possibly, in their perception, act against them if the company was to undertake a staff reduction initiative.

"If you reveal a safety problem the company may overreact and discipline somebody"; "The economical climate is uncertain so revealing any safety information could be used against us".

TRUST TOWARDS THE RESEARCHER

The word "researcher" could be replaced with a "change agent," as it better describes the function of the leader of the intervention. There was no paper known to the author discussing the role of trust towards a change agent during the process of organisational change intervention. Some advice for change agents may be found in the literature (DeRose, 2004; Falck & Barnes, 1975; Schein, 1997). However, none of these texts is research-based.

Although there is no research-based information about the discussed topic in the literature, the safety intervention participants indicated clearly that it was one of the reasons for their resistance. Operatives were suspicious that the researcher was acting to gather information about supervisors and managers. This belief resulted in their reluctance to share information with the researcher and cooperate.

"I had an impression that you gather info about management and supervisors' performance under cover of a safety initiative"; "We thought you were trying to check up on supervisors and management"; "We did not trust you"; "We did not feel we can share the information you asked us about with you".

ROLE DEFINITION

The perceived range of duties refers to the concept of organisational citizenship behaviour already discussed in Section 6.3.1.2. It appeared, based on the reactions of employees and their comments, that their roles were rigidly defined. Operatives came to work to conduct production-related activities only. They were happy to help a student with a university assignment,[20] but participating in an activity that required more paperwork was beyond their scope of duties. As the intervention needed their effort in a way that the operatives were not ready to accept, it triggered their resistance. It was expressed in opinions such as:

"Filling out questionnaires is not a part of my job"; "We are here for to work not filling out forms"; "We did not have time to fill these forms out"; "We were rushing filling the forms out as there was pressure on us".

FACE VALIDITY

This theme shows that an intervention developed mainly based on a theoretical model did not fit the very distinctive work environment according to the perceptions of operatives and created significant resistance. They indicated this fact by saying:

"I thought questions were not directly related to safety"; "We already had intensive communication about safety and we didn't need more"; "Providing feedback to supervisors every week did not make sense because we would just assess their moods not actual skills or behaviour"; "We did not want to hear from supervisors "work safely" more often than we did already"; "If we have a problem with a supervisor we tell them straight away and we don't need to fill out forms to do that"; "I didn't want a supervisor to remind me to work safely if I do my job safely"; "If we have a problem with a supervisor we go directly to the management and we don't need to fill out forms to do that".

[20] The company invites students on a regular basis for industrial placement, so employees were used to meeting students.

The experience of the researcher was that every department in this large company was very distinctive with different leaders, people, problems, financial resources, needs, group cohesion and motivational levels (see Chapter 6). Developing change interventions based solely on theory rather on contextual insights and variables risks failure because to achieve improvement, these very contextualised elements must be addressed according to the needs of particular departments and the people working in them. These conclusions are important in the light of the research indicating that one of the main factors affecting the success of a behavioural intervention is the level of participant involvement (Geller, et al., 1990) and this involvement is not likely to happen if the needs of individuals and groups are not directly related (Schwarzer, 2008).

NEGATIVE PAST EXPERIENCES

According to Vroom (1964) and George and Jones (2001), negative experiences from the past create expectations of negative experiences in future in a similar context. Workers recalled a number of examples of interventions from the past that either did not change anything in their perception or resulted in disciplinary actions against individuals. Therefore they were expecting a similar outcome from this intervention and, as they wanted to avoid the negative experiences, they resisted engagement.

“There was a number of safety initiatives before and most of them did not work”; “We had been let down so many times so we didn’t believe anything would change with your initiative”; “Most of safety initiatives in the past led to disciplining somebody and we didn’t want that from your initiative”.

TRANSPARENCY/COMMUNICATION

Despite our best efforts to communicate various aspects of the intervention, apparently the desired level of shared understanding of the premises behind the initiative was not achieved in the group of operatives. It was expressed in words such as:

“We didn’t quite understand what it is all about”; “We did not get enough information at the beginning about what was actually happening”; “The whole process was confusing”; “The language you used was not clear for us”.

This theme emphasises the importance of achieving a good and in-depth understanding of the rationale supporting an initiative in the group of operatives. As Allen, Jimmieson, Bordia, & Irmer (2007) showed, organisational change increases uncertainty and demonstrated that information-rich communication may reduce that effect.

ALIENATION

The concept of employees' alienation in their workplace has a long history. Marx (1932) suggested that alienation at work represents a loss of individuality and that this loss is something negative that should be avoided. Work alienation occurs when workers perceive work as detrimental to their values needs and well-being (Kanungo, 1982; Wegner, 1975). Employees express alienation by not asking questions, answering back or questioning management authority. The consequence of that is stronger rigidity, job dissatisfaction and a low level of organisational commitment (Cummings & Manring, 1977; Efraty, Sirgy, & Claiborne, 1992; Kakabadse, 1986). Seeman (1971) argued that alienation is a multi-faceted concept and includes sub-components: powerlessness (i.e. lack of control), meaninglessness (i.e. inability mentally to connect one's contributions to a larger purpose) and self-estrangement (i.e. when work is used only to fulfil external needs rather than being a source of self-expression). It is argued that the reasons behind alienation are centralised decision making, formal rules, policies and procedures that leave little space for individualised decisions (Moch, 1980; Mottaz, 1981). Other factors influencing alienation are the type of organisational structure (Ramaswami, Agarwal, & Bhargava, 1993) and leadership style (Shamir, Zakay, Breinin, & Popper, 1998)

The alienation of workers described in this chapter's intervention was expressed in words such as:

"We have done this work for years and there was no need to change anything"; "This initiative couldn't change anything anyway"; "You wanted too much from us"; "We didn't want to contribute to the creation of even more bars and charts".

As indicated by the above short literature review, alienation was expressed in the lack of motivation and empowerment. Although alienation is fairly well described in the literature, it was not discussed in the context of predicting the success of behavioural change intervention and, as indicated, it may play a crucial role in the process of implementation.

7.11.1. Summary

The analysis of the interviews with workers who took part in the intervention resulted in the development of seven themes that were considered by participants as having the biggest impact on them and their disengagement. All identified variables could be found in the literature as affecting employees' motivations, but they were not recognised as factors affecting the success of the implementation of safety interventions.

INTERVIEWS WITH THE PANEL OF EXPERTS

7.12. Method

7.12.1. Participants

As the aim of this study was to gather a wide range of perspectives on the process of the implementation of safety interventions it was decided to find and contact experts from different fields of expertise. There is a variety of professional groups on the market that work on improving safety in companies. Firstly, there are consulting companies that offer behavioural-based safety programs commercially. Another group of experts serves companies internally. They work full-time for one company trying to improve safety. Knowing that leadership is the core element of a successful change, there are groups of professionals working on leadership change, not necessarily focused on safety, called leadership coaches. They help to understand personality profiles, underlying assumptions, structures of beliefs and other psychological elements that may affect the behaviour of leaders. Finally, there is a group of academics who research safety culture and evaluate the effectiveness of safety interventions.

In order to find experts from the groups of specialties described above, an internet search was conducted that allowed the identification of a number of companies and individuals. That generated a list of companies and allowed identifying their contact details. An email message was then sent to all email addresses identified in the search containing an introduction of the researcher and the research itself. 16 individuals responded to the email - representatives of four professions: safety culture scientists (N=3), safety managers of large companies or corporations (N=4), directors of safety consulting companies (N=4), and leadership and organisational change coaches (N=5). The last group, although not directly related to safety, had much to say about changing leadership and management engagement, which are recognised as factors of the strongest power to modify the safety culture of a company (e.g. Diaz-Cabrera et al., 2007; Mohamed, 2003). All individuals who responded to the researcher's email and indicated an interest in participating in the research were interviewed. Names and achievements of the interviewees may be found in Appendix E.

7.12.2. Design

The main goal of the interviews was to understand what are the most common barriers to the successful implementation of safety interventions, what factors support that process and what would the experts do step by step if they were asked to implement an intervention in a large company. Two assumptions had to be made before the start of the data-gathering process. The first was that directors and consultants are very busy professionals and would only agree to a short interview. The second was that face-to-face meetings would not be possible, due to the disparate national and international locations of these individuals. It was decided that a 30-minute telephone interview would resolve these limitations. A special microphone allowing the recording of telephone calls was obtained. All interviewees were provided in advance with a list of five questions that would serve as prompts during the conversation:

1. Could you please briefly introduce yourself and tell me a few words about your work experience?
2. If you were asked by the senior managers of a large company to modify the behaviours of supervisors and middle managers, how would you tackle this challenge step by step?
3. How can we win the engagement of leaders towards a new change initiative introduced in a company?
4. What are the most common obstacles in the process of leadership behaviour change?
5. How can these obstacles be overcome?

It may be argued that such interviews should be conducted even before the first design of an intervention. However, neither the literature nor safety experts in the company suggested that there may be a need to develop a strategy for the implementation of an intervention. Instead, these two sources of information focused strongly on the method itself discussing concerns over “what method” rather than “how to implement it”. As the researcher relied mostly on these two sources of information when developing the concept of an intervention, he simply was not aware that the information available was not sufficient.

7.13. Procedure

The interviews with experts were mainly focused on obtaining information about the process of implementation of an intervention. Therefore the interviews sought to invoke the approach of experts to the behavioural change of employees and leaders in companies, detailing what to do and how to do it. The ultimate goal of this analysis was to create a meta-model of the process of safety intervention implementation based on the merged models of particular experts, not a list of themes. Different experts, depending on their field of expertise, focused on different elements describing what works for them in determining the success of a change process. For example, the approach of management coaches differed from the approach of in-house safety experts. There was an almost complete absence of overlap between their responses and suggested stages. However, the value of this study lies in appreciating the various styles of approaching a similar problem. It is also worth highlighting the fact that interviewees did not have a list of steps ready with them, but rather were constructing the structure of the process of implementation of a safety intervention during the conversation reacting to the probing questions asked by the researcher (see: process of verbalisation: Scholl, 2009). The outcome of such semi-structured discussion was lack of solid/rigid structure of the process. Experts tended to use metaphors, provide examples of their practice, change subjects of discussion, offer digressions, mention elements unrelated to the topic of discussion or finally get back to the early stages of the process of implementation during the discussion of late stages. As a result, the suggested stages of the process were not given in a chronological order.

The task of the researcher was:

1. To filter particular steps suggested by particular experts from all unrelated content such as digressions, unrelated examples etc.
2. To arrange these steps in chronological order.
3. To develop, for every person, a list of stages they recommended.

4. To merge all stages suggested by individuals into one central guide of what to do step by step in order to implement an intervention successfully.

7.14. Results

The merged instructions allowed the extraction of six stages of the implementation process.

1. Preliminary contact with senior management.
2. Assessment of the safety management system and safety culture.
3. Work with senior management.
4. Work with the Union.
5. Work with middle management and supervisors.
6. Work with shop-floor employees.

Every stage will now be broken down into steps.

PRELIMINARY CONTACT WITH SENIOR MANAGEMENT

The main goal of this stage is to understand the concerns of senior management and establish first contact. The panel of experts suggested focusing on the following elements during this stage:

1. Engage with the people who are asking for the work – senior managers
   a. What is the issue for them
   b. What is the culture that surrounds the behaviour
   c. What are the values of the organisation
   d. What are the formal and informal norms
2. Explore the thinking patterns and belief structures of the senior team who is promoting the change.
3. In the case of selling a ready-product, focus on indicating that problems in a company result from not having a behavioural program (or other program).
4. Agree to conduct a behavioural program.

ASSESSMENT OF THE SAFETY MANAGEMENT SYSTEM AND SAFETY CULTURE

The main goal of this stage is to recognise the quality of the safety management system and safety culture, as these are the factors that affect the implementation of an intervention. The detailed support for this is presented below:

1. Perform complete audit of the safety management system that the company has in place. Risk assessments, policies and procedures.
2. Ensure that the safety management system works well and has all the components.
3. Recognise culture:
    a. Organise focus groups or structured interviews and/or a questionnaire with as many levels as possible and investigate:
        i. What people say and think (as change requires the constructive challenging of underlying beliefs and assumptions).
        ii. What are the barriers for safety according to the workforce.
        iii. What do you have to do and what do you have to pay attention to in order to be successful in the company.
        iv. What behaviours tend to be rewarded around here.
    b. Recognise safety maturity level.
    c. Recognise national culture.

WORK WITH SENIOR MANAGEMENT

1. If possible take the group of senior leaders away from the organisation for at least a day or organise an alternative, day-long group meeting.
2. Show what the intervention is about and build an understanding of how it will work, what is involved and, what the benefits are (including financial ones).
3. Use examples of previous interventions and case studies.
4. Discuss research on motivation (why people do anything).
5. Play what if we do not do it.
6. Feed what you found to the managers and check that you got it right.
7. Discuss with senior managers:

   a. That they are part of the issue, part of the system and therefore part of any changes needed.
   b. What they have tried so far.
   c. What they are trying.
   d. In what ways SL are complicit in creating the situation that they currently have and do not like.
   e. What behaviours they (senior leaders) have to model to see change in the staff group.
   f. Research on giving negative feedback.
   g. Establish with them positive consequences for all major roles.
   h. Provide information on what the organisation will get and what they can expect to see happen.
   i. Present the theory of managing change (what happens psychologically to people going through change and transition) and link that to the behaviours that they must start demonstrating.
   j. What is necessary to support the change – how senior group can reinforce the change.
   k. What are the things blocking the way.
8. If possible, practise new behaviours and provide new experiences for SL through role-play exercises.

WORK WITH THE UNION

1. Obtain the buy-in of the Union.
   a. If you have successfully cooperated with unions in the past, provide contact details to the union with which you are cooperating at the moment so that it can obtain positive references of your past work.

WORK WITH MIDDLE MANAGERS AND SUPERVISORS

1. Form project teams.
2. Choose a champion.
3. Organise meeting/event/training session for middle managers:
   a. Invite senior, credible person(s) to the meeting

b. Do a lot of warm up exercises to develop trust (as trust is a condition for honesty and openness).
c. Discuss what they think need to change and what support they need.
d. Provide skills/techniques (training):
   i. How to communicate.
   ii. Why people do anything/motivation.
   iii. How positively to reinforce correct behaviours.

4. Establish processes for them to practise these skills.
5. Develop measures for these skills with them.
6. Assess them against these measures.
7. Develop disciplinary procedures for non-compliance.
8. Be prepared to move non-complying individuals.

WORK WITH SHOP-FLOOR WORKERS

1. Organise a (series of) meeting(s) with shop-floor employees:
   a. Mix employees from different working groups.
   b. Identify (by asking managers) who is the most influential in positive and negative way in particular working groups.
   c. Let them come up with ideas, choose the best ones and trial them to see which one works best.
2. Get the workforce involved in understanding the problem and providing their reasons for why people have accidents.
3. Raise awareness of why it is important for that change to occur by communicating:
   a. What is going to happen.
   b. Why it is going to happen.
   c. What the benefits are.
   d. Engage people in communication processes.
4. Build trust.
5. Whatever shop-floor workers decide, it needs to be signed by the management.

7.14.1. Summary

As the experts come from different fields of expertise their working methods differed, but the majority of them agreed on the basic three step approach: 1. Discuss with senior leadership their needs, 2. Investigate organisational/safety culture, 3. Engage others (middle management, supervisors, operatives) in cooperation. Despite this generic agreement every person offered a different set of tools and recommendations on how to approach the problem in detail. Hence with respect to the ways of cooperation with different groups of employees, there was no agreement between the experts. This is not surprising if consider the fact that experts have to sell their skills and do this by demonstrating the uniqueness of their approach compared to other companies on the market.

7.15. General discussion

The failure of the intervention left the researcher with a big unknown regarding the reasons behind the intervention's lack of success. The interviews helped to approximate the barriers that blocked the process of the intervention implementation. Two sets of interviews were designed to obtain different types of insight. Conversations with employees sought to gather a number of factors/themes that, according to the change participants, affected their motivation to take part in the program. On the other hand, interviewing experts intended to understand the process of implementation (what to do step by step and how to do it) rather than a specific set of factors affecting implementation. Therefore, to some extent the results of these two studies are difficult to compare.

With regard to the interviews with operatives it became apparent that the level of trust towards management and the researcher was not sufficient to maintain the cooperation. Additionally, negative past experiences, limited role definition, the face validity of an intervention, communication issues and alienation were obstacles from the point of view of shop-floor workers and supervisors. Although these variables are known in the subject literature, as discussed in Section 3, there is no study known to the author suggesting the assignment of these factors before the implementation of a safety-focused intervention. Despite the fact that the management is widely recognised as the factor shaping and affecting not only safety in general (Wirth & Sigurdsson, 2008) but also the success of the implementation process (Cooper, 2006), the number of safety-related interventions focused on improving safety leadership and changing managers' behaviours is incredibly limited compared to the number of studies devoted to changing employees behaviours (see Krause, 1999). Although the understanding of behavioural interventions focused on operatives is fairly well developed, there is not much insight about the process focused on altering supervisory/managerial behaviours. In this light, the failure of the intervention was in fact beneficial, as it provided an opportunity to explore what is recognised in the literature as a gap in knowledge (Wirth & Sigurdsson, 2008). However, despite the very informative character of the results of the interviews with the participants of the intervention, there are certain limitations that need to be discussed.

Firstly, it is argued (Gibbs et al., 2007) that the sample for a qualitative study should represent a variety of researched subgroups and be diversified in order to comprehend cases that do not fit the currently developing understanding. An attempt was made to address this issue, so 50% of the interviewed sample comes from the supervisory group and 50% from the group of operatives. With regard to the diversification of the respondents, it is important to emphasise the context in which the study took place: after the intervention, the majority of operatives completely refused to cooperate and there was no possibility for the random drawing of the individuals. Instead, the researcher received a favour from the individuals with whom he had the best relationship and who, despite feeling resistance, decided to spend some time explaining their perspective on the process. In that context, it is argued that their agreement to talk to the researcher is an advantage rather than a limitation. Nevertheless, in terms of theoretical requirements, the sample diversification is certainly limited.

With regard to the size of the sample Crouch and McKenzie (2006) argue that since qualitative research "*scrutinizes the dynamic qualities of a situation (rather than elucidating the proportionate relationships among its constituents), the issue of sample size – as well as representativeness – has little bearing on the project's basic logic,*" thereby defending small samples. However, the problem of data saturation may be raised. Interviews should be conducted until no new issues emerge (Gibbs, et al., 2007). This is certainly a disadvantage of this study. It is unknown whether other operatives could provide additional insight into the motives that affected the intervention. It may be argued that as the operatives work in fairly small groups (3-10 people per shift), they discussed the problem within their groups and the interviewees expressed shared concerns. However, this assumption does not have any empirical validation. Undoubtedly, as the results are very contextual, they cannot be generalised to other populations.

Another concern refers to the so called response distortion processes. These are cognitive filters that may deform the answer of an interviewee. The relevance of this concern is high in this case as interviewees were drawn from the sample of participants engaged in the intervention that failed. Therefore it is expected that they would be emotionally engaged and for a number of reasons their responses could be distorted by the filters. Scholl (2009), an experienced qualitative market researcher, discusses five filters that contribute to the misrepresentation of the respondents' attitudes. Thee are: forgetting, suppression, verbalisation, justification and pleasing. All of them could have affected the respondents in this study. As the interviews took place a few weeks after the intervention finished, their memories might have faded and knowledge may have been compromised. As a result, their reported recollections may have omitted some elements. However, it is argued that memories affected by strong emotions are more easily recalled and are retained in the accessible memory for longer (Richards & Gross, 2000). Suppression is a process that takes place in order to suppress the attitudes that seem less acceptable. It may be argued that, due to the low level of trust towards the management expressed by the interviewees, they suppressed the information that they were afraid to disclose. It may also be possible that two themes in particular - role definition and alienation - were biased by the process of justification, as only these two refer directly to the motivations of operatives. Justification is a cognitive response filter that occurs when respondents feel under some pressure to sound reasonable. Motivation to please the researcher might have also existed. However, all of these suggestions are speculative and, despite the risk of response-distortion processes, the data are still novel and valuable. Nevertheless, caution must be exercised in interpreting or generalising the findings.

With regard to the interviews with the safety professionals, the results presented in this chapter are unique in the sense that the "know-how" of experts is usually kept within their businesses and serves as a selling point and as such is not willing revealed to the public. An additional distinctive feature of these results is the focus on the process of implementation instead of on themes. Insight into what to do and in what order is much more informative and helpful for practitioners than only a list factors that support or obstruct the process.

The analysis of the interviews showed that there is substantial variation and minimal agreement between the representatives of different safety-related professions with regard to the stages of implementation. This is surely affected by the fact that professionals functioning in the free market must differentiate themselves from their competitors and develop unique approaches. It may also be affected by the fact that different professions (e.g. safety manager and leadership coach) occupy different niches and are potentially employed in different types of projects. For example, traditionally, safety managers are responsible for the formal aspects of safety in companies, such as procedures, policies and legal compliance, and leadership coaches help senior leaders to improve their self-awareness and leadership style. However, merging these different styles of approach leads the development of an in-depth understanding of a variety of problems and ways to solve them.

It is apparent from the results of the interviews with the experts that the main focus is placed on cooperation with the management at different levels of the hierarchy. This is understandable, considering that all managerial/supervisory positions have power that they can use to support of oppose an intervention, and without the engagement of leaders a change program is doomed. It seems that the main focus in the cooperation with the management is placed on developing mutual trust within subgroups and between levels of hierarchy, investigating their needs, increasing awareness of individuals with regard to the process of organisational/behavioural transformation, providing training for new skills and jointly developing an improvement plan. But all of it is targeted at more efficiently managing the workforce. The workforce itself must be supported in order effectively to cooperate with the management staff who provide the direction of changes. The support may be expressed, according to the experts, by involving operatives in the design of a change program, communicating in detail a variety of aspects related to the anticipated intervention and building trust.

However, does the insight provided by the experts overlap with the barriers that affected the researcher’s intervention? The answer is positive, although the overlap is not literal. As the experts provided the insight about the process of implementation and the intervention participants provided a number of reasons, these are two different types of information. However, it may be argued that the panel of experts suggested some steps in how to avoid the difficulties encountered during the intervention attempt. The transparency/communication theme is addressed in points

6.1.1. and 6.3. (in the section discussing the results of the analysis of the interviews with the experts), where, by raising awareness and mixing working groups, the problem of resistance due to lack of information would be limited. Point 6.1.3, in which operatives are allowed to develop their own ideas that, are later tested, addresses the issue of face validity. Point 6.2, suggesting educating the workforce on why people have accidents and helping them understand the problem, may possibly affect their role definition. Identifying and engaging the most influential individuals seeks to prevent alienation/passivity. Choosing a change champion (point 5.2.) – a trusted member of a team – is to improve trust towards a change agent. It is difficult to improve trust rapidly or erase memories of negative past experiences. If the trust is low and the past was rich in negative events, it may take as much as two years to improve those variables.

The problem of the best practice of implementation of safety interventions is virtually non-existent in the subject literature. The only process map known to the researcher was published by Wirth& Sigurdsson (2008). However, it was based on the authors' experience rather than on any systematic investigation. It is also narrowed exclusively to a behavioural process that aims to change operatives' behaviours and not managerial behaviours. The process consists of 20 steps in a defined order. In short, the authors suggested to initiate the process and obtain buy-in, conduct risk analysis and provide feedback to the management and the operatives, develop and revise a behavioural checklist and feed that back again, provide safety training and observer training, conduct observations, provide feedback to both groups, organise a meeting of the safety committee, compile and post safety data, celebrate success, reinforce the process, provide feedback on the process and review the process. The two steps that are mentioned in the paper but not by the interviewed experts were "celebrating success" and "revising the process". Both steps appear to make sense and are worth adding to the list of steps that must be undertaken in order to implement a safety-focused intervention effectively. All these findings offer a novel interpretation of the failure, and challenge Zohar's model of behavioural change.

The developed intervention (see Chapter 7, Study 1) was largely based on the theory of multi-level leadership, which, from a theoretical point of view, seems to be very strong and relevant. Zohar's intervention, developed on the basis of this concept, was very effective. However, the failure of the application of a very similar program of change of operatives' behaviours by engaging supervisors and managers showed that there were factors that influenced the process of implementation that were not described in Zohar's study.

The failure of implementation of the intervention (see Chapter 7, Study 1) showed that, despite following the theoretical models from the literature with added insights from the company, the intervention not only failed, but was also perceived as unwanted and inadequate within a department.

What is striking in the description of the process of the implementation of Zohar's intervention (2003) is the fact that he introduced a concept to the company and everyone not only agreed to take it on board, but fully engaged in the process (except 4% of the workforce). The whole process of implementation was seamless and smooth. Participants behaved like programmed robots. There were no difficulties with time pressure, with production priorities competing with the intervention, with interpersonal conflicts, with trust towards management etc. All these problems were encountered during the intervention designed for the purpose of that thesis and they were predicted by the panel of experts. A question may be raised on the reason behind these differences. A number of potential answers may be suggested:

1. These variables were ignored by Zohar and not included in his paper, despite existing in the companies with which he cooperated;
2. The companies in which he implemented his intervention incorporated his ideas in a perfect way, and no such difficulties emerged;
    a) Possibly the organisational and/or national culture in which Zohar's intervention took place promoted a hierarchical top-down approach. It may be assumed that Zohar conducted his research in Israel, where he works. According to one of the panel experts, a strong top-down approach would be accepted only in some cultures:

"Quite often we have multinational companies that are either American or UK led. We are moving to a country without an earned cultural belief and you have to lead by observing that particular culture. So, for example, in Singapore there is a very strong compliance culture, so doing something like behaviour-based modification and root-cause analysis is not a problem; the issue you would have there is usually a delay in response. With Malaysia and to some degree China, those regions, what we have is honour. They never publicly want to be displayed or embarrassed, so things like doing one-to-one feedback must be done very carefully if at all. What we may look at is peer feedback, where you take measures, collect the information and give it to the group rather than to a single individual. The Chinese in particular are very proud people and you have to remember that sometimes political frameworks, whether it is a police state or democracy, are a major factor in how people behave. When you go to the Middle East you will see similar issues about faith and pride, but you may consider looking at group feedback. When you go to the West Indies it is a very hierarchical, very competitive, very individualised kind of society, so you are going to try constructing things again differently, not worry about the collective whole."

Following this lead, an Internet search was conducted in order to identify some clues about what may be the Jewish working culture. The Jewish Agency for Israel (Feierstein, 2010), an organisation that coordinates the employment of foreigners in Israel, describes the style of solving problems at work in the following words:

"At work, Israelis tend to prefer to resolve differences through direct communications, often conducted in a spontaneous manner with demonstrative forms of speech, including the use of confrontation, speaking loudly, and direct criticism."

It seems that this short note very accurately mirrors the approach that Zohar took. What is even more interesting is the continuation of this note targeted to Americans:

"Since Americans tend to favour indirect communication styles and a more formal manner of speech than their Israeli counterparts, you may find yourself feeling overwhelmed, defensive or upset during such demanding encounters."

It would appear that Israeli officials have recognised what effect this direct style of communication has on people from different cultures. Although this is just a generalised note that which cannot serve as a descriptor of the working cultures of the particular companies that cooperated with Zohar, it provides an extremely valuable insight into how national culture might affect safety intervention. It also introduces the notion that the intervention failed because the intervention type was not appropriate, not only for the culture in the company, but also for the national culture of the UK.

The process of implementation of safety improvement intervention described in Zohar's paper does not discuss the variables that determined the success of the implementation of the intervention for this study, or the variables discussed by experts as crucial in the process of implementing such an intervention.

In the light of the evidence on why the intervention based on Zohar's model did not work, two hypotheses may be offered. The first one is that Zohar failed to discuss (or even maybe consider) a number of variables. The second one is that the national culture played such an important role that the same method could result in substantial improvements in the Middle East and fail in the UK.

From the interviews with the change participants, it became apparent that there were many factors playing a role in their engagement that were not mentioned in Zohar's study. According to the panel of experts, the process of implementation (regardless of method/tool/theory for change) should include a number of stages and involve a number of groups. Preliminary contact with senior management should be established in order to recognise their needs and their thinking patterns, and to obtain their perceptions and agree to the type of program. Next, an extensive assessment of the safety management system and safety culture should be performed in order to establish the position of the company and potentially other problems that should be solved before the implementation of the intervention. Senior management should then be involved in the process of developing the intervention that they can expect in the organisation, discussing their role in the process and the ways in which they can support the process. They should be trained in what is involved in the behavioural transition and how to react to problems. Independently, the union should be engaged and should support the process. Following that, middle managers should be involved in the process of preparation by forming project teams and choosing a champion. Training should be provided in how to reinforce correct behaviours, how to communicate, build trust and other related skills. They should be informed of what they can expect happen. Finally, the group of shop-floor workers should be prepared to participate in the intervention by discussing with them their needs, gathering and implementing their ideas and identifying and engaging the most influential individuals.

Based on the findings presented above, it is suggested that future research should focus to a greater extent on the development of interventions focused on changing managerial and supervisory behaviours, especially if those are recognised as the most important factor shaping the safety culture(s) of companies. Within that process, special attention should be paid to the development of best practice strategies and identifying barriers for change, ways to overcome them and a set of conditions under which the barriers occur and may be counter-measured.

It also appears that national cultures determine what types of communication can be used and thus what type of feedback can be used. As feedback is one of the main tools used for behavioural change it is crucial to understand in what countries a certain type of feedback is preferable and most effective. The most common barriers for change in different cultures and the best ways to overcome them in different cultures must be established.

Additionally, it is suggested to look more closely at the strategies employed by different professionals that aim to modify organisational/safety culture(s), behaviours of line employees, supervisors, managers and directors. It is argued that practitioners hold very valuable experience that could be investigated in-depth and tested for efficiency.

7.16. Critical findings

1. In response to the failure of the safety intervention (see Chapter 7, Study 1), an investigation was undertaken to understand the reasons for employees' resistance, which included interviewing the intervention participants and external safety experts.
2. The intervention participants indicated that the following factors influenced their motivation to participate in the intervention: the level of trust towards management and the researcher was not sufficient to maintain cooperation. Also, negative past experiences, limited role definition, the face validity of an intervention, communication issues and alienation were obstacles from the point of view of shop-floor workers and supervisors.
3. The interviews with safety experts allowed the extraction of six stages that should be followed in order to implement a safety intervention successfully: initial contact with management, recognition of safety management system and organisational culture, cooperation with senior management, and cooperation with Union, cooperation with middle managers and supervisors, cooperation with blue-collar workers.
4. The factors identified by the change program participants and the stages of implementation indicated by the experts were not discussed in Zohar's original study.

5. It is hypothesised that Zohar did not mention these factors in his paper, or that these factors do not play an important role in Israeli culture.

Chapter 8

Safety Culture Improvement Intervention no 2

8.1. Introduction

The intervention described in Chapter 7 used a model of influencing employee safety behaviour based on theoretical models drawn from the literature (Zohar & Luria, 2003). The decision to focus the intervention on front-line supervisors was rooted in insight from earlier qualitative work (see Chapter 5) and supported by a model from published findings, specifically from (Zohar, 2000, 2002a, 2002b; Zohar & Erev, 2007; Zohar & Luria, 2003).

Intervention One targeted the supervisors and managers (as suggested by qualitative research and the literature review), but failed for a variety of reasons (see Chapter 7), including a low level of trust towards the managers and the researcher, negative past experiences, limited role definition, low face validity of the intervention, communication issues and alienation. Furthermore, the interviews with experts provided an extensive list of suggestions on how to increase the likelihood of success of an intervention implementation. The list of the identified elements was long and varied. The identification of factors responsible for the failure of the first intervention did not provide much insight into how to improve trust, improve face validity, communicate better or reduce the level of alienation. The interviews with intervention participants did not reveal what culture is, or how to change culture. It only helped to identify barriers that prevented a certain programme from being implemented in a certain context. The main premise suggesting that the culture of a group of employees in a work environment is shaped by the behaviours of leaders (supervisors and managers) remained unchanged. Therefore the main goal of the second intervention was similar to the goal of the first intervention – to attempt to modify the leaders' behaviours.

The researcher faced a difficult challenge on how to translate the lessons learned from the implementation of the first intervention to the second intervention. Firstly, without a clear answer on how to do it, a literature search was conducted, aiming this time at project management and change management studies in order to identify some guidance on increasing the chances of success. The literature search helped to conclude that new programmes should be closely integrated with the existing management system (see the review below), which potentially could help to address some of the barriers identified in Intervention One. Strong integration with the existing system could help to increase the face validity of the programme. There was the potential that only amendments to the existing system would not be perceived as new and unfamiliar. Furthermore, in order to address the issue of communication and trust, the barriers identified in the previous study (see Chapter 7), the researcher decided to spend more time with supervisors and managers and involve them in the design of the intervention. It was hoped that the potential issue of the role definition of supervisors and the departmental manager (another barrier identified in the previous study, see Chapter 7) would be affected by the engagement of senior and middle managers (as suggested by interviewed experts, see Chapter 7), who were provided with regular reports on the progress of the intervention. There is another approach towards the design of change programs within organisations-based on the notion of integrating the design of change methods with the context of particular departments - that is said to be more effective from the project-management point of view. Engwall (2003) argues that procedures employed to achieve change within organisations need to be looked at from the perspective of previous and current activities, plans for the future, operating procedures, traditions and cultural norms. His research findings suggest that the better the alignment of a program with established ideas, structures and patterns of behaviours within an organisation, the higher the probability of a smooth and successful execution of a project. Similarly, Lehtonen & Martinsuo (2009) analysed two complex organisational change programs and discussed the advantages of program-parent integration, demonstrating that an understanding of context is essential for success. A limitation of these studies, however, is the qualitative, ethnographic methodology based on observation and description of only two case studies. This issue was partially addressed by Pellegrinelli, Partington, & Hemingway (2007), who analysed the way in which projects were implemented in six large private and third sector companies. Their findings suggest that successful change programs were constantly reshaped and rearranged, in an iterative manner, to fit the particular moment and situation. Furthermore, Maaninen-Olsson & Mullern (2009), based on an analysis of successfully managing high-tech projects, concluded that context is a fundamental element (see also Ferns, 1991).

A limitation of these studies is the fact that they do not compare the effectiveness of integrated and non-integrated, projects but only describe ongoing programs. Nevertheless, it appears that the majority of papers on the subject are in agreement regarding the benefits of the integration of intervention design with established organisational structures, systems and cultural norms.

In the manufacturing sector, survival is directly related to the efficiency of production capabilities. In an atmosphere of harsh competition, companies must continually improve efficiency and quality while at the same time reducing costs. The sponsor company uses a number of strategies to achieve this including an approach called Continuous Improvement (CI). According to Sim & Roger (2009), CI "is defined as any methodology or program that continually strives to improve any and all processes through an increase in quality, delivery, productivity or customer satisfaction and/or a decrease in lead-time, cycle time, cost or scrap" (p. 38). The CI approach includes Total Quality Management (TQM) and lean production tools. Both were applied in the study organisation and its parent group.

TQM includes a philosophy and assumptions about successful work as well as applicable tools and processes to put into operation. The first assumption behind TQM is that the businesses that produce higher-quality products will be more successful than the companies that compromise on quality (Hackman & Wageman, 1995). Lean manufacturing as a concept and method of production improvement was originally developed by two Japanese engineers, Taiichi Ohno and Shigeo Shingo, for the purpose of increasing the efficiency of production in Toyota factories in Japan. The system has been widely adopted by large companies in the U.S.A., UK and other countries (Arnheiter & Maleyeff, 2005). Lean production has a number of goals (Pettersen, 2009): (a) to produce products with fewer defects, (b) to improve value by reducing waste, and (c) to achieve high quality and low cost in a short time. Lean production system proponents offer a number of tools and techniques designed to achieve the above goals. The most widely adopted 31 principles are listed in the literature review conducted by Pettersen (2009).

One of these tools is "Standardised Work". It is very important to automate as many stages of production as possible (Liker, 2004) in order to improve the speed and quality of the production process. In classical understandings of the lean production system, the term "Standardised Work" refers to a very detailed description of every step of work conducted by operatives (Ohno, 1988), including material (stock), machines, work sequence and timings. Work standardisation plays a very important function in the continuous production process (Dennis, 2002). It ensures process stability, allows organisational learning, audit and problems solving, employee involvement and training. More recently, however, Mann (2005) suggested the development of standardised work for leaders as well (including supervisors and managers), along with the standardisation of the work of shop-floor employees.

The standardised work for leaders is simply a list of their responsibilities structured on an hourly/daily/weekly/monthly basis. Every item on the list is set in agreement with the superiors and subordinates of a person for whom the list is designed. Every item must be unequivocal and is assessed with a binary system: "done" versus "not done". The job of a leader using the standardised work sheet is to go through it item by item within specified time frames and mark which tasks were done and, if not done, to note why not. The main function of the standardised work for leaders is to make their daily/weekly/monthly responsibilities structured in order to switch their attention from outcomes to the process of –production. The items focus on keeping the flow of production and support other elements of the lean production system. For team leaders the ambition in the company is to define 80% of their time, for supervisors about 50% and even less for middle and senior management. The big advantage of using standardised work for leaders is said to be the ability to recognise weaknesses in the production support process. A supervisor's list is reviewed regularly by his/her manager and based on the written record, they can easily identify the problematic areas. Additionally, every person clearly knows what is expected of them and how to perform their duties. In the case of personal changes within a department, the flow of work is kept going, as new comers continue to perform the most crucial actions according to the list.

Keeping in mind the importance of the benefits of designing change programs that fit well with established cultural and socio-technical norms, an attempt was made to configure a more organic safety improvement intervention that is context-driven rather than theory-driven. To this end, an avenue that was considered was to explore the scope for aligning a safety intervention with established and valued management systems. This was thought to bring at least two benefits: firstly, it would link the intervention to established practices, rather than attempting to introduce new, additional and unfamiliar practices; secondly, it had the potential to integrate safety more closely within the broader productive process, rather than treating it as an add-on or separate activity.

It was argued that out of all available management and lean manufacturing methods used in the company the standardised work for leaders offers the highest relevance to achieving intended goal which was the modification of supervisory behaviours and improvement in interactions about safety with shop-floor employees.

As the researcher was the only person coordinating, supporting and evaluating the intervention, it was decided, due to time and resource constraints, to limit the intervention to only one department and choose a second one as a control group. Therefore, identifying the appropriate department was the first stage of the research process.

8.2. Method

8.2.1. Identifying the appropriate departments for an intervention

In February 2009 a new shop-floor manager was recruited to a large finishing department. This presented an opportunity to explore innovative ways of enhancing safety.

“Large finishing” relates to the size of the products (metal casting) being manipulated and worked on, rather than the size of the department. The finishing of castings is a high-hazard activity, involving the use of blasting media, removal of flashing surplus metal and trimming/finishing using mechanical belt grinders. In addition to this, there are hazards associated with supporting tasks, especially mechanical and manual handling activities. The principal hazards relate to rotating machinery and equipment, product and materials handling systems, e.g. forklifts, manual handling, chemical exposure and noise.

With regard to the control department, the most hazardous task was Electrical Discharge Machining (EDM), which will be described in some detail here due to its salience in subsequent sections. Commonly known as spark erosion, it is essentially a type of grinding/abrasion process; a typical task consists of removing a component from a storage rack and, submerging it in a hot oil bath before abrading the surface with the spark erosion ‘gun’. This includes the manipulation of the component in the tank and its removal on completion. The hazards associated with this process include electric shock, inhalation of oil mist and fume exposure, manual handling, noise, slips and trips and fire.

The Human Resources department strongly suggested that the researcher should not gather demographic information about the participants of Intervention Two, expressing concerns that the personal data could not be protected as expected by law (Data Protection Act 1998). Similarly to the description of the participants of Intervention One, only very generic information can be provided about the employees of the two departments (experimental and control groups). All participants were male and between 30-60 years old. The majority of them worked for the sponsor company for more than 5 years. They worked in their departments for the majority of this time. Their work required a fair amount of communication and cooperation. As the group of managers and supervisors was very small, all information about these individuals could lead to their identification and for this reason was not included.

8.3. Materials

8.3.1. Developing standardised work safety criteria for leaders

It needs to be highlighted at the outset that the implementation of the standardised work for the leaders focused on production processes had begun two months before the researcher’s intervention started. Therefore it was a new program in this particular department. The researcher contributed to its development by identifying safety-related elements that could be added to the SWFL tool.

A meeting with the departmental manager was organised to discuss the idea of merging standardised work for leaders with safety items. It was agreed that, in order to maximise the potential for engagement of supervisors and win their support / ownership for the intervention (Moch, 1980), they should contribute to its development, specifically of the safety elements that would be added to the list of assessed criteria. Following suggestions from the literature (Hilyer, Veasey, Oldfield, & McCormick, 2000) with regard to training development a workshop-based meeting was organised for front-line supervisors with the objective of developing a list of safety-related behaviours that the supervisors would agree to exhibit.

During the supervisory workshop participants were:

1. given instruction in the form of a short lecture summarising key insights on employee risk taking, including what safety culture is and the influence of leadership on employee behaviour;
2. asked to identify a range of changes in supervisor behaviour that, in their opinion, could have a positive impact on shop-floor workers' safety behaviours;
3. shown the list of behaviours identified by Zohar (2002b);
4. engaged in a discussion of both lists, leading to the identification and agreement of a set of supervisory safety enhancement behaviours.

Following that workshop, a meeting with a member of the senior management team and supervisors was organised to agree on a definitive set of supervisor behaviours. The discussion resulted in the definition of the set of behaviours given in Table 32.

Table 32. *A set of safety-focused behaviours identified with supervisors*

1.	Check to see if all shop-floor workers are obeying the safety rules.
2.	Discuss with workers how to improve safety.
3.	Spend time helping workers learn to see problems before they arise.
4.	Use explanations (not just compliance) to get worker to act safely.
5.	Say a "good word" to workers who pay special attention to safety.
6.	Remind workers who need reminders to work safely.

A central principle of the standardised work perspective is that items must be worded in a way that allows for binary assessment - YES or NO - based on the premise that problems should be unambiguously and easily identifiable. Moreover, as other items in the standardised work for leaders related to the production process are worded in such a way as to allow binary assessment, the safety items, in order to fit the layout, had to be adapted to that format. The wording of the items was adjusted to meet this criterion:

Table 33. *A set of rephrased safety-focused behaviours identified with supervisors*

1.	Did you observe that everybody in the department was obeying all safety rules?
2.	Did you interact with an operator to share any of his/her ideas to improve safety?
3.	Did you check with an operator if he/she noticed any environment issue that can potentially harm his/her workmate?
4.	Did you educate an operator about the hazard related to the work being performed?
5.	Did you recognize an operator for performing the task to the safety standards?
6.	Did you educate/remind an operator on any of the safety rules?

One more item was added to the list:

7. Did you check with an operator if he/she came close to injuring themselves?

Item 7 refers to the Injury Free Event (IFE) program running in the department during the period of the intervention's implementation (see Chapter 5). The main goal of this system is to identify hazards and risks in the work environment, identify root causes and remove them. As the focus groups (Chapter 5) and the safety culture questionnaire (Chapter 6) showed, there was resistance towards the use of the IFE system. From the management point of view, IFE books help to track risks and hazards and allow the systematic review and removal of critical dangers. As workers did not want to use the IFE books, it was argued that personal and frequent interaction between supervisors and workers about risks and hazards may help to identify them. The IFE books could then be used to record the nature of a hazard and enter it into the computer system to allow the raising of maintenance tickets and to be used for data-gathering purposes. The standardised work for leaders with the identified safety items may be found in Appendix F.

8.4. Procedure

The intervention consisted of adding the seven behaviours to the standardised work for leaders used by supervisors in order to encourage frequent verbal interactions with workers on the topics covered by the list.

Each supervisor was asked to go through the whole checklist at least three times a week (as agreed with them and their manager) and approach seven shop-floor workers a day, during their shift, and discuss at least one item from the list with at least one employee. The supervisors were instructed that they should tailor their discourse with each employee to reflect the degree of observed compliance with good practice, so if a supervisor saw somebody working according to the safety rules, he should praise them (one item), and if the supervisor saw somebody breaking a safety rule, they should remind them about working safely, and so on. The supervisors were asked to record on paper a short note describing each of the specified interactions with each employee. The routine was carried on for 20 weeks. A manager of the large finishing department was asked to check the compliance of supervisors at the end of every week and, in the case of non-compliance, to investigate the reasons for it. The researcher agreed to meet with supervisors and their manager at the end of every week to collect the "*Standardised Work for Leaders*" sheets and discuss any issues or difficulties in applying the scheme with participating supervisors.

8.4.1. Impact Measures

The evaluation had a pre- and post-test design, with evidence of change being derived from employee perceptions of multi-level safety climate, Leader-Member Exchange, Safety Citizenship and the Job Security questionnaire. This was supplemented with a behavioural audit check list that provided the monitoring of employee behaviour change. These were exactly the same methods used in the first intervention (see Chapter 7) and the rationale for its use may be found in Chapter 7. As the new behavioural checklist had to be developed to reflect department-specific hazards (see Appendix F), the method application was the same as described in detail in Chapter 7.

For the purpose of gathering pre-test data, the observations of safety behaviours were conducted for four weeks before the start of the intervention and were continued until the 24th week of the intervention. Observations were conducted 3-5 days a week and an average score was calculated for each week. Each observation session lasted up to 30 minutes.

The pre-test questionnaires were administered in mid-March 2009 in the Large Finishing department and in EDM at the beginning of April 2009. The different dates reflect local arrangements with departmental supervisors who had to choose the timing so that it did not adversely affect the production processes. Post-test questionnaires were administered in the 24th week of the intervention (second half of November 2009) in the Large Finishing and EDM departments.

8.4.2. Difficulties with the process of implementation

Despite the supervisors' expressed willingness to follow the process outlined above and interact with operatives according to the themes stated on their list, and despite their managers' agreement to monitor their compliance, in most weeks they failed to perform their tasks according to the agreement. In most of the weeks, when the researcher saw them at the end of a week, the supervisors apologised for not completing the task but promised to complete it the following week. However, at the end of each subsequent week, the pattern was repeated, despite commitment from their manager to encourage adoption, the weekly review of supervisor responsibilities and the discussion of the reasons for failure to complete the defined instructions with shop-floor staff. The process of trying to engage supervisors to adopt the intervention took 20 weeks, and in that time they returned eight sheets out of 60. Also, as far as the researcher is concerned, the supervisors also failed to follow other items from the SWFL tool, not just those related to safety – demonstrating challenges related to people management at the company.

8.5. Results

8.5.1. Observations

Observations were conducted in both departments three to five times per week. Safety performance expressed as a percentage value (ratio of observed safe behaviours to all observed behaviours multiplied by 100) was calculated for each day and these scores were averaged for each week and plotted on a graph on a computer. Figure 12 presents the averaged weekly results of observations, where the first four points are the four weeks of the baseline. The graph shows much variance within the large finishing department from week to week, varying from 55% to 75%, whereas observations from the EDM department are less varied. The calculations of the results will be discussed in the following sections.

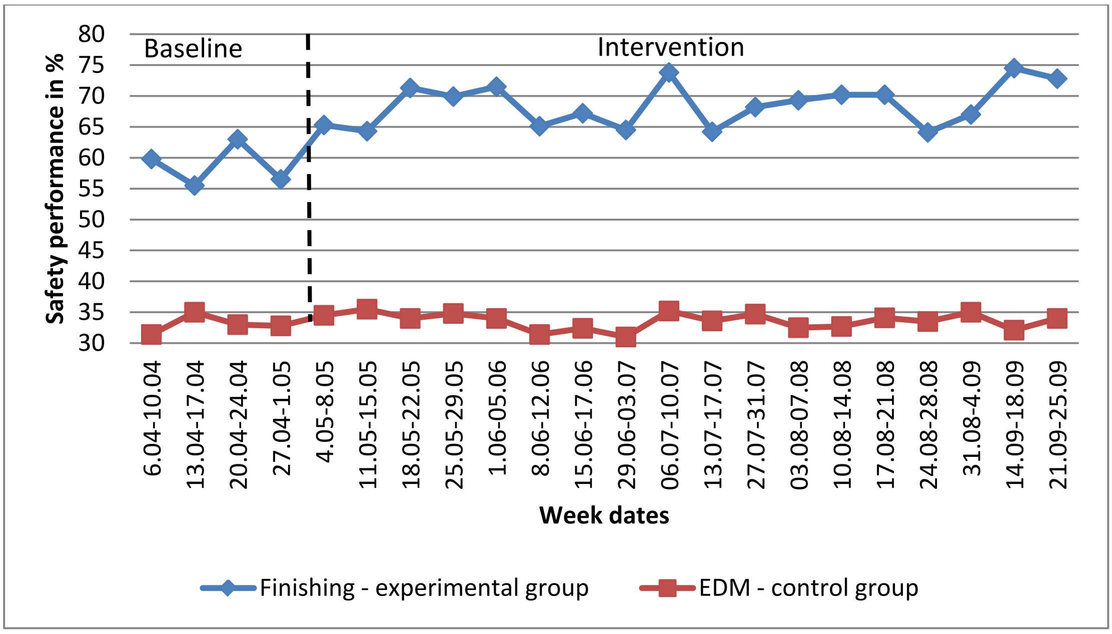


Figure 9. Average weekly safety performance for experimental and control group.

One-way repeated-measures ANOVA for the cleaning department (experimental group)

For the purpose of statistical analysis one-way repeated-measures ANOVA was used. Observations from every month created one variable. The order of observations was matched; it means that the first observation in Month 1 was matched with the first observation in Month 2, 3, 4, 5 and 6 and similarly for the second observation and the subsequent ones. This was important, as in one-way repeated-measures ANOVA the effect of manipulation is analysed on the basis of within-participant variance, not between-group variance (Field, 2005).

According to Mauchly's test, the assumption of sphericity was violated ($\chi^2(14)=26.65$, $p<.05$). For that reason the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon=.52$). The results show that the behaviour of employees differed significantly in particular months $F(2.61, 20.94)=3.62$, $p<.05$, $\omega^2=.28$[21] (see Appendix F).

In order to identify which months differed, two types of contrasts were tested. Firstly, "simple contrast" was applied to compare months in which intervention was taking place with the first month (base line). There was a statistical difference ($p<.05$)

[21] Calculated according to the equation (Field, 2005): $\omega^2 = \frac{[\frac{k-1}{nk}(MS_M - MS_R)]}{MS_R + \frac{MS_{BG}-MS_R}{k} + [\frac{k-1}{nk}(MS_M - MS_R)]}$
where: k – is the number of months in the intervention, n – number of observations in every month, MS_M – mean square for the model, MS_R –residual mean square, and MS_{BG} –between group mean square.

between the first month and all other months: Month 1 vs. Month 2 $F(1, 8)=5.55$, $p<.05$; Month 1 vs. Month 3 $F(1, 8)=18.87$, $p<.005$; Month 1 vs. Month 4 $F(1, 8)=7.04$, $p<.05$; Month 1 vs. Month 5 $F(1, 8)=28.58$, $p=.001$; Month 1 vs. Month 6 $F(1, 8)=7.68$, $p<.05$ (see Appendix F).

These results suggest that in the Cleaning department the behaviours of employees in May (the first month of the intervention) and the following months improved significantly compared with April (base line).

In order to establish whether the improvement was stronger in each subsequent month compared to the previous one, the "repeated contrasts" measure was applied. "Repeated contrasts" allowed the comparison of Month 1 with Month 2, Month 2 with Month 3, and so on. The results indicated that there was only a difference between Month 1 and the Month 2 $F(1, 8)=5.55$, $p<.046$ (see Appendix F).

The findings suggest that the behaviour of employees improved significantly in May (the first month of the intervention) compared to April (base line) and then stayed at approximately the same level until the end of the intervention.

One-way repeated-measures ANOVA for the EDM department (control group)

Mauchly's test was not significant, confirming the assumption of sphericity of the data ($\chi^2(14)=15.87$, $p<.05$) (see Appendix F).

The results show that there were no significant differences between particular months during the baseline period of the intervention $F(3,40)=1.59$, $p>.05$, $\omega^2=.027$[22] (see Appendix F).

8.5.2. Questionnaires

Two-way ANOVA analysis for the cleaning department (experimental group) and EDM department (control group)

In order to check whether the intervention had any effect on the perceptions of shop-floor workers regarding their leaders (organisation and group levels safety climate and LMX) as well as their perception of job security and the perceived scope of their responsibilities, a two-way ANOVA analysis was conducted, comparing the results obtained before and after the intervention in an experimental and control groups. The Levene's test was conducted in order to test for the homogeneity of the

[22] Calculated with the same equation as the effect size for repeated measures one way ANOVA for the cleaning department.

data and it resulted in significant values for “group level safety climate”, “job security”. To address this issue Welch’s and Brown-Forsythe’s tests were conducted in order to modify *F* and the residual degrees of freedom in order to address violation of the homogeneity of variance. The performed tests resulted in significant values for both variables below $p<.05$ threshold allowing to reject the null hypothesis and continue the analysis.

The results showed that there were two significant main effects only for the “safety citizenship” variable suggesting the differences between pre-test / post-test ($F(1,87)=5.85$, $p<.05$) and between experimental and control groups ($F(1,87)=5.42$, $p<.05$). There was no significant interaction effect between the impact of the intervention and the groups (departments) for that variable. There was not any significant main effect or interaction effect for any other impact measure. The detailed results of the analysis can be found in the Appendix F.

In order to break down the main effects post-hoc analysis should be performed; however post-hoc tests could not have been performed as there were less than three groups. Therefore, a t-test was conducted for “safety citizenship” variable to compare pre-test and post-test in experimental and control groups (see Table 34).

Table 34. *T-test analysis for experimental and control groups for “safety citizenship” measure.*

Safety citizenship	Pre-test, N=36		Post-test, N=21		Pre-test, N=16		Post-test, N=18	
	M=69.47	SE=3.71	M=54	SE=5.42	M=54.43	SE=6.65	M=46.16	SE=3.09
	$t(55)=2.42$, $p<.05$, $r=.31$[23]				$t(32)=1.17$, $p>.05$, $r=.20$			

The results show that “safety citizenship” improved significantly in the experimental group (the lower the mean, the more safety-related behaviours operatives consider a part of their job) after the intervention, compared to the baseline. There was a non-significant improvement in the control group with regard to that variable.

Correlation procedure for the impact measures

In order to explore the covariance between the impact measures (see section 8.4.1.), a correlation procedure was conducted on the data gathered from experimental

[23] Effect size calculated according to the equation (Field, 2005): $r = \sqrt{\frac{t^2}{t^2+df}}$

and control groups (cleaning and EDM departments), before and after the intervention.

The test of normality of distribution for particular variables turned out to be significant for three out of five variables suggesting that the data for Job Security ($p<0.000$), LMX ($p<0.05$) and Safety Citizenship ($p<0.005$) were not normally distributed. The significance values for the Kolmogorov-Smirnov test may be found in Appendix F.

As the data were not normally distributed, the non-parametric test for correlation coefficient had to be used. Out of two commonly used coefficients - Spearman's *r* and Kendall's tau - it is argued (Howell, 2009) that the latter provides a better estimate of the correlation. The results of the correlation procedure may be found in Appendix F.

The results showed that organisation-level safety climate correlated strongly with group-level safety climate ($\tau=.55$, $p<000$) and Leader-Member Exchange ($\tau=.24$, $p<001$). Group-level safety climate correlated strongly with Job Security ($\tau=.34$, $p<000$) and Leader-Member Exchange ($\tau=.37$, $p<000$). Additionally, Job Security correlated significantly with LMX ($\tau=.23$, $p<005$).

Regression analysis for the impact measures

As the sponsor company was going through long and painful process of redundancies before and during the intervention, it was expected that this protracted situation would affect employees' perceptions of job security. Strong job insecurity my decrease safety motivation and compliance with safety rules (Probst & Brubaker, 2001), so it was considered justified to check whether that variable predicted changes in other impact measures.

In order to check whether "Job security" predicted the strength of "Group-level safety climate," a simple regression analysis was conducted. It turned out that "Job security" accounted for 27.6% of the group-level safety climate variation (see Appendix F).

Based on the analysis of variance (see Appendix F), it can be concluded that "Job security" predicts "Group-level safety climate" $F(1)=30.08$, $p<0.000$.

The same analysis was conducted to test whether "Job security" predicts the strength of "LMX". The predictor accounted for 16.2% of variance in LMX (see

Appendix F) and predicted the outcome of LMX significantly $F(1)=14.87$, $p<0.000$ (see Appendix F).

"Job security" also significantly ($F(1)=8.52$, $p<0.005$) predicted "Organisation-level safety climate," but accounts for only 8.7% of the variance (see Appendix F). However, job security did not predict Safety Citizenship scores $F(1)=0.75$, $p>0.5$ (see Appendix F).

8.6. Discussion

The repeated-measures one-way ANOVA demonstrated that the behaviour of employees changed significantly compared to the baseline in the experimental group, but there was no equivalent change in the control group. As discussed earlier, supervisors followed the program of the intervention to a minimal extent, providing only eight "Standardised Work for Leaders" sheets during the period of six months. It is unlikely that they completed more sheets than they returned, as they mentioned many times that they did not do it due to lack of time. This suggests that the intervention was unlikely to have a significant impact on supervisor behaviours, and ultimately the behaviour of shop-floor workers.

Based on these results a number of questions may be raised:

- If not the intervention, what affected employees behaviours as evidenced by the observation data?
- If not the intervention, what affected the safety citizenship of shop-floor workers in the experimental group?
- If not the intervention, what could account for the apparent change in employee perceptions of safety climate?
- Why did the intervention fail to work as intended?

A possible answer to the first point is: the impact of a production-improvement intervention that began at the same time (May, 2009) as the researcher's safety intervention in the experimental-only department. The production-related initiative focused on implementing a number of changes in order to reduce the amount of inventory in the department and increase the output. The departmental intervention was led by the departmental manager and was supported by a Rapid Operational Improvement Programs (ROIP) team. The ROIP team was created by the corporation in order to support the operational processes of plants which that struggle to achieve their maximum manufacturing potential. The team consisted of multi-national experts in Management Systems and Lean Manufacturing. The team was invited to the company to redesign production processes in the Wax and Foundry departments; however, it also supported the Large Finishing department. In May (the same month as the beginning of the researcher's intervention) the large finishing department initiated a number of Lean Manufacturing Initiatives (LMI):

1. Help chain – the idea behind the program was to provide operatives with a tool for asking for help when they encountered a production problem, the aim being to solve the problem immediately. The operatives were given a visual sign to call their shift leader for assistance. If the shift leader could not resolve the problem immediate contact should be made with the supervisor. If a supervisor could not solve the issue, a departmental manager was called in and ultimately a senior manager. The main goal of the initiative was to solve problems that interrupt or have the potential otherwise to disrupt the production process. This initiative may have affected employees' perceptions of the effectiveness of solutions provided by the company for the problems they reported and reduce their frustration. However, no measure of this variable was applied, so no relationship can be demonstrated. It addressed a number of problems indicated by employees, which were described in the Chapter 5 and expressed during individual interviews (see Chapter 4).
2. According to the experimental departmental manager, he and supervisors spent up to three times more time on the shop floor interacting with employees regarding production issues, observing employees working and analysing the production process than they had prior to the introduction of the LMI. Although the main focus was on production, it is likely that safety elements were picked up spontaneously during that process.
3. The introduction of the KANBAN pull system. A single work-station is set up in such a way as to allow suppliers visually to identify whether any components are needed to keep production going in that workstation without engaging an operator. As a part of this initiative, the floor around the machines and work stations was painted using different colours to indicate places for parts ready for processing and

ready for another stage of production. The implementation of this initiative had the potential to enhance the degree of control over inventory in the department and improve housekeeping, as every component, box or case had its own clearly designated place. This is clearly one of the elements likely to have a positive impact on housekeeping performance, as evidenced in the observation measures.

4. “Setup Time Reduction” and “Just-in-Time production” were implemented to complement the KANBAN pull system. This helped to smooth the flow of a part through particular stages of production.
5. The overall look of the department was improved. The walls, floors and walkways were painted. Additionally, a program of cleaning machines to improve its appearance was applied.
6. A standardised work through visual management program was implemented. For every stage of the production process a list of crucial checks was developed and put on a notice board or a wall in an appropriate place close to that stage. Supervisors and manager had to walk from board to board, go through the list and mark with one colour the status of every check. Green was OK, Orange – caution, RED – needs immediate attention. This system allowed a better control of the processes.

As far as the researcher is concerned the implementation of the SWfL was abandoned a few months after the end of the intervention. In general, the improvement of production efficiency through the application of the lean manufacturing system is related to the reduction of inventory in the department and the increased output. It seems likely that a side effect / by-product of the production-focused intervention was improvements in the standards of housekeeping and consequent reductions in housekeeping-related hazards. The combined effect of the implementation of the above initiatives may be responsible for the observed improvement in safe behaviours, as it reduced the number of hazards in the department, especially those associated with housekeeping.

While the above production changes seem likely to have contributed to improved safety performance in terms of the check list criteria, this does not immediately account for the measured improvement in safety citizenship. Additionally, the question arises as to why this was the only cultural variable that exhibited a significant change after the intervention compared to the baseline. It may be hypothesised that the LMI production initiatives reduced the frustration of employees with regard to their daily routines, materially improved working conditions with respect to the presence of hazards and being provided a timely and well resourced resolution of employee-raised issues. It appears possible that this change could lead to enhanced employee perceptions of organisational citizenship, including safety citizenship. However, as the impact of these initiatives was not measured, the hypothesis cannot be confirmed.

Despite the fact that the improvement in the safety citizenship measure was the only one that was significant, it was observed that the mean values for safety climate and job security are lower at time two, although non-significantly, indicating that the perception of departmental and organisational leaders with respect to their safety engagement declined. On the one hand it may be hypothesised that this change may be a result of a measurement error; on the other hand, at the time of the implementation of the intervention the company was going through a difficult process of redundancies in order to reduce production–related costs. Within that context the deterioration of job security is an expected effect and this is what the data show. The employees' perceptions of job security, measured by the "job-security scale", worsened after the intervention in comparison to the baseline. These results could possibly be explained by the changes in supervisory duties that took place during that time. The departmental supervisors were engaged in two-fold responsibilities. On the one hand, they were engaged in the intervention focused on improving the production figures through the implementation of lean manufacturing elements. On the other hand, during the redundancy process the supervisors were obliged to assess every employee and suggest to the senior management who should be made redundant. Supervisors themselves were also at risk. The strong focus on production-related tasks may have potentially reduced the amount of time and attention allocated to safety. Additionally, deciding who will be made redundant may be expected threaten the relationships between operatives and their supervisors. These two effects could be gauged by the measures: group level safety climate and LMX. The results show that the safety climate declined, but not the LMX. A potential explanation of why the process of the redundancies did not affect the relationships between workers and supervisors may be the fact that the post-test survey was administered shortly after the process of redundancies was finished and all people designated by supervisors had left. The people who stayed may have felt saved or chosen by their supervisor. However, with regard to safety climate, the production intervention was still running so limited time was spent directly on safety. Furthermore, with regard to the decreased safety climate, the exploratory analysis was conducted in order to find the covariance with other variables. The findings show that job security correlates significantly with group-level safety climate ($p<.000$) and Leader-Member Exchange ($p<.004$). In order to confirm whether job security affected safety climate, a simple regression analysis was conducted. The results of that procedure showed that job security significantly predicts group-level safety climate, organisational-level safety climate and LMX but it did not predict the safety citizenship improvements. Therefore it may be argued that the effect observed in this study may be attributed to the production improvement intervention.

If that was the case, this finding would have two profound consequences. Firstly, it would suggest, contrary to many studies (Janssens, et al., 1995; Mearns, Whitaker, et al., 2001; Zohar & Erev, 2007), that the reduction of hazards and risk may be achieved in accordance with the improvements in production speed and efficiency. So far in the literature it has been argued that, in order to increase production figures, pressure had to be put on workers and their leaders. In that context, safety competes with production for time and resources, and often loses that competition. In a production pressure situation, workers cut corners in an ttempt to save time, and are more stressed and less careful. This may result in accidents and such production pressure is a sign of a weak safety culture (*ibid.*). However, it appears that lean manufacturing focuses on different sets of assumptions. Instead of working harder and faster, it promotes working smarter, with high workforce engagement (Pettersen, 2009). It is difficult to relate this result to the literature, as the research about the impact of the implementation of lean manufacturing on safety is almost non-existent, even despite the fact that, within lean philosophy, accidents are considered an extreme form of inefficiency and are to be avoided at all costs (Wokutch & Vansandt, 2000). There are some notes and discussions about the subject in the grey literature (Campbell, 2009; Hallowell, Veltri, & Johnson, 2001; Manuele, 2007; Savasta, 2003). Although an advantage of these publications is the shared knowledge of experts, the papers are not based on data and rigurous statistical analysis. There were three articles found in peer-reviewed journals discussing this issue. Two of them report a positive impact of lean systems on safety and one argues that the impact was negative.

Nikolou-Walker & Laver (2009) compared two departments in a manufacturing company. In one of them a lean production system was implemented. Based on the interviews with employees, the authors concluded that a lean operations system improved the production flow, the department itself was better organised (e.g. tools and equipment were easily found) and the layout of the process improved as well. The new system influenced safety with better signage of hazards, a cleaner work environement, fewer trip hazards and better ergonomically designed work stations. A minority of employees indicated the negative impact of the system on their work, as they felt anxious and stressed due to the change in the production process. These two studies demonstrate a clear similarity between the effect described in them and the benefits of implementing lean manufacturing tools in a cleaning department like KANBAN or help chain.

Saurin and Ferreira (2009) studied the impact of the lean manufacturing system on working conditions. They interviewed Health & Safety experts from the company after the process of implementation was accomplished. The safety specialists reported dramatic positive changes in terms of culture and safety. They said that the engagement of top management increased and it was understood that safety is not only a concern of the H&S department. The system also improved housekeeping by establishing storage areas and controlling stock. According to shop-floor employees from the same company, the improvement in housekeeping was the most noticeable change.

However, these results were not confirmed by Brown (2007). He found that in a Chinese factory the implementation of a lean manufacturing program increased the number of hazards. It exposed employees to a bigger number of risks, increased workloads and put employees under stress. However, in his study, the company completely redesigned the production process, merging numerous stages of production previously conducted by different people in different departments into one continuous process of production from the beginning to the end, performed by the same individuals.

This research shows that there is no agreement with regard to the impact of lean manufacturing on safety. However, similar results are found with regard to the impact of lean systems on working conditions, which is a broader term than safety and includes elements like - work organisation, work content, monotony, pain and discomfort, autonomy etc. Ferreira (2006) analysed 52 scientific studies about the relationship between lean manufacturing and work conditions, and found that 48% of the citations referred to positive impacts and 52% to negative impacts on work conditions. She explained that this variation may be caused by: (a) the company's culture and the extent to which safety and ergonomics play a crucial role, (b) the different level of maturity of lean systems, (c) the socio-economic context of the company (rate of unemployment, labour standards, the role of unions) and (d) the extent of the workforce's engagement in the process of implementation of lean production systems.

If that is the case, it may be argued that in the sponsor company the success of the production improvement intervention was a combination of the elements identified by Ferreira (2006). It is unlikely that the so-called Hawthorne effect took place in the department, as the observed hazards (such as items on the floor) were affected directly by the lean manufacturing improvements described above.

Having discussed the potential reasons that affected the behaviours and hazards in the department, what affected the intervention must be considered. On the basis of the subject literature (see Chapter 2), the opinions of the experts described in the previous chapter (see Chapter 7, Study 2) and the researcher's first-hand experience from the process of implementation, a number of plausible reasons that could account for the failure of the intervention might be provided. Zohar & Luria (2003) suggest that, in order to make an intervention successful, a manager should be involved to affect supervisory behaviours. Although this advice was applied and the departmental manager attempted to discuss with supervisors their progress, this method did not produce the expected results and the supervisors did not follow the process. In fact, the inclusion of the manager should not be crucial, as Zohar's intervention (2002b) demonstrated that significant improvement of safety-behaviours and safety climate may be achieved without the engagement of the middle manager. The negative outcome suggests that there were other factors in the process of implementation that Zohar did not mention in his study.

As mentioned in the section above - "Difficulties with the process of implementation" - supervisors struggled to follow both the production–related items and safety-related items. A number of speculative explanations may be offered with respect to why the supervisors did not follow the agreed process:

1. The departmental manager who was involved in the intervention was not convinced by the merits of the program and so did not use all of his influencing skills to engage supervisors.
2. The departmental manager did not have the necessary skills to engage supervisors.
3. The departmental manager did not have sufficient power to influence his supervisors.
4. The supervisors did not think that the intervention could help, but for whatever other reason agreed to take it on board. According to Liker (2004), people taking part in an intervention, based on standardised work for leaders, must be convinced, in the first place, that elements put in the standardised work for leaders are important. Therefore the conclusion is that it is not enough to create a list of duties and ask supervisors and managers to follow it. An important factor is also their emotional engagement, understanding the importance of new tasks and valuing the outcome that certain behaviours on the list should bring.
   a. Based on the three years of the researcher's experience of the company, it is plausible to suggest that the supervisors uncritically accepted the intervention and agreed to follow it, as it may be a common pattern of reacting to all new programs introduced by the corporation. In the qualitative analysis of the focus groups, the participants said that the corporation imposes a number of new initiatives on the company every year and they cannot refuse to accept it. However, there are no serious consequences for not following the introduced programs. Over a long period of time, such an approach could develop a pattern of behaviours whereby all new initiatives are accepted but not necessarily followed up.
5. The manager and supervisors did not receive training on how to influence people positively and, as the analysis of the experts' suggestions shows (see Chapter 7, study 2), providing training and providing opportunities to practice new skills is an important element of changing leader's behaviours. Therefore, in this case, without training the impact was limited.

6. The process of redundancies affected the motivation and engagement of supervisors.
7. Other priorities drew the attention of the manager and supervisors away from the intervention.

These speculative explanations provide an overview of the factors that could affect the intervention. From the researcher's personal experience of the company, point 4a appear to be the most plausible. However, it is not possible to evaluate the likelihood of the above-listed reasons due to the lack of relevant data.

This complicated situation and discussion over the causes of the observed effects leads to a more generic problem of conducting research in organisation. The most common approach practiced by scientists is the administration of questionnaires in organisation. It can be done by visiting a company or even by sending surveys by post without visiting the place being studied. In the review of the advantages related to conducting research in organisations Rynes & McNatt (2001) found that approximately a quarter of surveyed authors (141 studies) did not spend any time at the organisation they were investigating. The limitation of that approach is the lack of insight into contextual variables. This thesis is an example of this problem. If the researcher had not been present at the company site for a long period of time, or had he just visited it from time to time, he might have attributed the observed change in behaviours to his intervention. By doing so he would have made a Type I error, concluding that the safety intervention had had an effect, when in fact there had not been one. This observation is consistent with the findings of Ryness & McNatt (2001). They concluded that *"Increased on-site hours (of researchers) were associated with significantly greater personal learning, more surprising research findings (r = .24), greater likelihood of change implementation, and higher perceived quality of the resulting research—characteristics that have all previously been identified as factors associated with more significant research projects."*(p.17).

If that is the case, it may be argued that a large proportion of organisational research may involve Type I or Type II errors, incorrectly inferring casual links, or at least not fulfilling their potential. From the scientific progress point of view, these studies, detached from the phenomena being studied, may contribute to the "scientific noise", which means adding new findings (of questionable relevance) to the pool of results, and this process makes it more difficult to retain the results that adequately describe the reality. The overall effect of this may be the slowing down of scientific progress.

8.7. Critical findings

1. Based on the conclusions from the process of application of the first intervention (see Chapter 7) and additional insights from the literature about the advantages of integrating a change program with existing management tools (see Chapter 8), it was decided to extend the Standardised Work for Leaders (SWfL) tools through the inclusion of safety-related elements.
2. Based on discussions with the management and supervisors, a list of supervisory behaviours was established. The behaviours concerned verbal interactions between supervisors and shop-floor employees on a variety of topics related to safety e.g. reminding about safety rules or praising safe behaviour. The new behaviours were added to their SWfL list containing other, production-related routines.
3. Supervisors were asked to go through the list at least three times a week, interact with at least seven shop-floor workers and deliver the evidence of their interactions to the researcher.
4. Despite new, safety-focused supervisory behaviours having been added to the already existing management tool (SWfL), used on a daily basis to manage production-related supervisory and managerial routines, the method failed to motivate supervisors to follow the prescribed and agreed-upon instructions. The speculative explanations for this include the lack of managerial engagement, cultural assumptions that a new idea must be accepted but not necessarily executed, the lack of training provided to the supervisors and managers, or the process of ongoing redundancies.
5. Nevertheless, in the experimental group a statistically significant improvement in safety behaviours was observed in the first month of the intervention compared to the base line. The improvements remained at a fairly constant level until the end of the intervention. In the experimental group there was also a statistically significant improvement in safety citizenship. In both groups, group-level and

organisation-level safety climate as well as job security declined but non-significantly.

6. On the basis of the researcher's access to contextualised information and knowledge about other initiatives undertaken by the company, it is argued that the reduced hazards and improved safety citizenship could be attributed to the production-improvement-focused intervention, implemented simultaneously with the researcher's safety intervention, that reduced the amount of inventory in the department, improved the general cleanliness and engaged operatives actively to identify issues interfering with production.
7. The deterioration of the safety climate scores was explained and predicted by the job security scores, which were predictably lower after the intervention due to the redundancies introduced by the company.
8. The embedded approach to the research allowed avoiding of Type I error by having access to the information that is otherwise inaccessible to researchers investigating organisations while remaining detached from the phenomenon under study.

Chapter 9

Discussion

9.1. Safety culture assessment

9.1.1. Overview

The main goal of this thesis was to develop safety culture interventions based on the theoretical insights. The approach to intervention development was based on established theory and practice, and informed by grounded contextual insight. The approach broadly followed the recommendations of Galloway (2010). This author suggests seven steps to assess safety culture in companies: (a) review of documentation, programs and policies; (b) early communication with employees; (c) conducting a location walk; (d) discussion with leaders; (e) developing a bespoke / customised safety culture survey; (f) conducting focus groups with stakeholders; and (g) providing a report on actionable items (see also Kello, 2009; McDonald, Corrigan, Daly, & Cromie, 2000).

While many studies in this domain are limited to either a quantitative or a qualitative approach, with by far the majority of studies reflecting the former (see Cox & Flin, 1998; Fitzgerald, 2005; Jeffcott, et al., 2006), authors such as Antosen (2009) have demonstrated the benefits of adopting a combined-methods approach. Antonsen's approach was taken in this thesis for the process of safety culture assessment, especially the use of a mixed-methods design to generate complementary insights. In recognition of the potential advantages of a triangulated approach, Chapters 3, 4, 5, and 6 offered an in-depth insight into how and in what ways a variety of salient variables affect safety culture in the sponsor company. The assessment of safety culture(s) was informed by a review of published material in the domains of risk taking at work, workplace safety culture / climate, organisational climate and organisational change literature.

The qualitative and quantitative evidence collectively offered insight into not only what was important, but also into how the identified variables were important.

This insight was used to develop two safety culture interventions, each focused on leadership behaviour. One was based on a replication of Zohar's work on the multi-level leadership model (2002b), and the second one on an adaptation of Mann's Standardised Work for Leaders model, a technique not previously applied within the safety domain (Mann, 2005).

In general the investigative process described in this thesis may be divided into two parts: (a) assessment of safety culture; (b) development, implementation and evaluation of safety interventions. The first part is composed by Chapters 4, 5, and 6 and the second part from Chapters 7 and 8. Therefore it was decided to structure the final discussion section according to this division. The research focused on the investigation of safety culture will first be discussed along with its limitations and conclusions, and the attempt to improve safety through the interventions will then be analysed.

9.1.2. Assessment of safety culture

Attempts to explore and assess safety cultures within the company were conducted in three complementary stages: (a) familiarisation with productive processes, procedures documentation, safety performance data and intervention history followed by shop-floor visits to each department, individual non-structured conversations with a cross-sectional sample of staff representing a wide array of job-roles and functions across the company; (b) focus group discussions with a cross-section of staff; and (c) workforce safety culture questionnaire. The order of the application of these methods allowed the careful development of insight into the main elements affecting employees' perceptions and behaviour. The non-structured conversations helped with understanding the vocabulary used by employees, the tasks they performed and their perspectives of hazards and risk. This was valuable in itself, while also offering insight into topics that could be explored more rigorously in the focus groups and the safety culture survey. The primary limitation of the qualitative investigations related to issues of generalisability of the findings. The safety culture survey, built on the findings from the focus groups and individual interviews, offered an opportunity not only to calculate the distribution of responses but also to explore the differences between different groups.

Separate analyses were conducted on the focus group and survey data, with a common objective of identifying component constructs, derived on the basis of a thematic analysis and a factor analysis, respectively. These analyses reflected a high degree of commonality in terms of the nameable constructs identified, and their constituent facets / components (see Table 35).

Table 35. *Comparison of dimensions of safety culture derived from qualitative and quantitative evidence.*

Individual interviews	Focus groups	Safety culture questionnaire
	Reactive approach	Solving problems
Leader's people skills	Leadership	Leadership
Reporting	Reporting	
Breaking rules	Breaking rules	Risk taking
Pressure	Pressure	
Communication	Communication	
Job security		
	Corporate identity	
	Training	
		Estrangement

Common constructs from the three different trenches of data are highlighted in grey. Table 35 indicates that there are two dimensions that were common for all three studies: (a) leadership; and (b) breaking rules / risk taking. Time pressure was shared by both qualitative studies and reactive approach / solving problems was shared by focus groups and the questionnaire results.

Table 35 shows that the application of three different methods to different samples of respondents yielded similar results. On the one hand this is a strong argument for the construct validity of the methods used; on the other hand, it shows the value of using a mixed-design approach. For example, with regard to "leadership," participants in the individual interviews indicated that the people skills of leaders were important to them. This was explored and confirmed in the focus groups, where respondents highlighted issues regarding the lack of sufficient frequency of interaction with leaders as well as the inconsistency in their approach to safety rules enforcement. The focus groups also helped to understand in what ways these concerns affect employee attitudes and behaviour in relation to safety. Finally, the survey helped to confirm that this is a consistent dimension across departments (α=.87) explaining 14.8% of the variance in 2008. The measure also highlighted differences between departments, e.g. in 2008 employees from the ceramic core and alloy department exhibited the most positive perceptions of their leaders, while workers from the mould preparation and foundry departments had the most negative perceptions of their supervisors and managers.

With regard to the hazard / injury reporting theme, informal conversations with shop-floor employees and supervisors indicated that underreporting is a concern for them. Focus groups helped to clarify that reporting accidents and minor injuries / incidents are two separate issues, where resistance to report the former arises from the extensive paper work involved and the issue of blame, whereas unwillingness to report the latter comes from the lack of feedback and poor face validity of the reporting system.

Risk taking is another common dimension. Negative behavioural norms amongst long-serving staff and leaders, turning a blind eye to infringements by leaders, the persistence of irrelevant / outdated safety rules, poorly designed equipment and production pressure were all cited as factors contributing to the reduction in the motivation of shop-floor employees to comply with safety rules and procedures. The relatedness of these components was confirmed by the Principal Component Analysis performed on the employee survey data, this variable explaining 14% of the variance in 2008.

Beyond these three factors there are two pairs of dimensions shared by qualitative work as well as focus groups and the survey. The reactive approach / solving problems, despite the different labels, appear to refer to the same phenomenon: employees' perspective that supervisors and managers only engage with hazards and safety issues following an incident / near-miss, and are not responsive to employee concerns. The employee focus groups revealed high levels of frustration and demotivation to engage with safety issues due to what was perceived to be a reactive approach to safety on the part of managers and supervisors. The survey evidence appeared to confirm the salience of this dimension, which was found to explain 13.8% of the variance in 2008. The scale also revealed significant variance between departments, with effect size of differences ω^2=.040 in 2008.

A communication dimension was also identified in both qualitative studies. Qualitative findings highlighted an array of facets of communication in terms of linkages with employee safety performance, and specifically: feedback from manager over safety concerns raised by employees, the profile of safety issues at staff meetings and the quality of the safety information passed on at shift handovers. Questionnaire items related to communication were scattered around different factors. The Principal Component Analysis did not isolate communication as a separate component.

There are also four dimensions identified by particular methods and not confirmed by others. Individual interviews indicated "job security" as a concern. In 2007 in individual interviews employees expressed their concern that in the case of an economical downturn they may lose their jobs. That became a prophecy, as in 2008 the company started a redundancy program. Focus group results indicated that "training" may be a serious limitation for strong safety performance, as new comers did not receive sufficient on-the-job training on the risks associated with their tasks. The focus group results also suggested that "corporate identity" was a factor affecting management to a large degree, mostly in a negative way, due to the leadership style of the corporate representatives, who tended to impose tasks on the local managers without consultation or analysis of that available resources. Finally, an "estrangement" factor was extracted from the survey data (α=.70) explaining 9.9% of the variance in 2008. The effect size for the differences between departments was ω^2=.026 in 2008.

The fact that the safety culture dimensions differ to some extent appear to be a natural effect of applying different methods to research the same phenomena. For example, Lee (1998) used focus groups in the nuclear power station to develop a safety survey. The PCA analysis produced 19 factors that aligned with only five out of the seven themes identified in his focus group analysis. The potential for a discrepancy between qualitative and quantitative results was also empirically confirmed by Sackmann (1991), who suggested a compromise between using interviews and questionnaires after the consideration of the limits of both methods. The differences in the findings stemming from the application of different methods appear to be inevitable and are caused by the limitations of particular methods and methodologies (see Chapter 3), the imperfections of the researcher and the extraordinary complexity of the researched phenomenon (including work environment and the human element) (Shipman, 1997).

All of the identified themes - irrespective of the method of the investigation applied - have already been acknowledged in previous research. Possibly the most extensive coverage was devoted to the "leadership" dimension (Hahn & Murphy, 2007; Hayes, et al., 1998; Prussia, et al., 2003) (for a full list see Chapter 5). Similarly, elements relating to "hazard / incident reporting" are already reported in Edmondson (1996), Fung, et al., (2005), and others; "risk taking and rule breaking" in Lawton (1998) and Mohamed (2003); "reactive approach" in Fleming & Lardner

(2002a) and Marais, et al., (2006); “communication” in Berends (1996) and Cox & Cheyne (2000); “job security” in Probst (2003) and Probst & Brubaker (2001); “training” in Diaz-Cabrera, et al., (2007) and Lawrie, et al., (2006); and “estrangement” in Cummings & Manring (1977) and Efraty, et al. (1992).

The only dimension not found in the literature but identified in the focus groups was the “corporate identity” (see Chapter 5). It is perceived as a very contextualised aspect stemming from the recent take over of the company by a large multinational corporation.

Although the majority of identified constructs have previously been identified in the subject literature, the composition of elements is unique to this study. A number of attempts has been made to establish a universal model of safety culture (Clarke, 2000; Farrington-Darby, et al., 2005; Seo, et al., 2004) but the transparent inconsistency in the findings, beyond a small number of core variables: “management commitment, “supervisor commitment” and “compliance with rules” raises questions over the logic and credibility of this endeavour (see Chapter 2). An alternative perspective is that different variables with different emphasis / relative importance between different workplaces (possibly within the same organisation) should be expected, i.e. combinations of cultural dimensions may depend strongly on contextual variables in different workplace contexts (Guldenmund, 2000). In this sense the current study research confirms the findings from the literature in appearing to identify a set of variables that reflect findings from other studies, but with a structure / relative salience of its own.

It is held that the value of this study lies not in confirming or refuting the results in the literature, but in offering a contextualised understanding of the work environment and of the employees’ safety-related perceptions.

9.1.3. Alternative strategies

With regard to alternative research designs that could have been applied, it would have been possible to change the order of application of methods. Some researchers (e.g. Donald & Young, 1996; Fitzgerald, 2005), for example, advocate using an established safety culture survey in the first instance and exploring the results with employees through focus groups. A strength is said to be the insight that can be derived from the contextualised discussion and articulation of issues. This approach is more time-efficient as it does not require the analysis of qualitative material in order to develop a contextualised safety culture survey. However, a potential disadvantage of that approach, as Galloway (2010) notes, is that using a generic off-the-shelf survey may contribute to overlooking important elements of culture that are specific to a particular organisation. Although at the time of configuring the research design the researcher was aware of this alternative, it was argued that beginning the research with less structured qualitative work would have a two-fold advantage: contextualising the understanding of the local culture from the very beginning and helping the researcher to develop his own understanding of the concept of safety culture and its constituent elements in the company.

A further alternative considered was to apply participant observation techniques as part of an ethnographic approach, at least in the initial stages of the study. Although there are a number of advantages of an ethnographic approach in terms of its potential to produce highly detailed insights into the behaviour of employees and the underlying rationale and underpinning orientations, a disadvantage is that it is highly labour-intensive, raises questions over the generalisability of findings due to the inevitably small sample and, more pragmatically, there are obstacles to securing senior management permission to gain access to employees at this level.

With regard to alternative methods of data analysis for the qualitative data gathered, a number of concurrent methods of analysis of verbatim data exist. Thematic analysis was chosen over narrative analysis, interpretative phenomenological analysis, grounded theory, content analysis or discourse analysis as it offered the outcome most suitable for the development of the planned safety culture questionnaire, which in turn, informed the decisions over the selection of topics and departments for intervention.

Finally, with regard to alternative methods of quantitative assessment and characterisation of safety cultures, there is an abundance of questionnaires available in the literature. The researcher found more than 40 measures published. However, it was decided to build one based on qualitative insight to ensure a high level of embeddedness of items in the company’s context. The adopted strategy turned out to be successful, as the five-factor solution that was derived explained 55% of the variance in 2008 and 60% in 2009.

9.1.4. Limitations

The study has a number of limitations. First, the sample used in each method was limited and does not allow for the generalisation of the findings to the population. Individuals for unstructured interviews were chosen on the basis of their availability, rather than in any systematic or random fashion, and at times the researcher was guided in terms of who to talk to by members of the Health and Safety team. The focus groups involved five of the largest production departments, based on the assumption that the participants would represent the perspectives of the functions that employed the most people on the site. However, smaller departments were omitted. With regard to both qualitative studies, a further limitation relates to the lack of a second coder with whom a similarity of attributed codes and definitions could be compared and correlated (Shadish, Cook, & Coampbell, 2002).

With regard to the quantitative measure, the response rate to the safety culture survey was modest: 43% in 2008 and 35% in 2009. On the one hand it covered less than half of the workforce; on the other hand, in order to calculate statistical differences only large departments with ±20 people were chosen, offering insight into only a limited number of divisions. Therefore smaller groups were not involved and hence the scope for understanding the sub-cultures of small departments was limited.

Something of a holy grail in safety culture arena is demonstrating a connection between employee survey data and accident rates. As demonstrated in the literature review (see Chapter 2), consideration was given to correlate the obtained results with an injury rate. However, due to the anonymous character of surveys (see Campbell, Vasquez, Behnke, & Kinscherff, 2009), individuals from this research could not be linked to their injury record from the organisational database. Therefore it was not possible to establish a link between employees' perceptions of safety and their injury rate.

Moreover, it is possible that all data gathered from respondents could suffer from the evaluation apprehension bias, in which researched individuals claimed that safety is better than it really is due to their fear of being identified. However, such effects should be minimised due to the fact that no personal data were gathered at any stage of research. Alternatively, it might be argued that, as the company was going through a protracted process of ongoing redundancies over the period of 2008-2010, those respondents who were concerned over their job security might have been motivated to present safety as worse than in reality, as a form of expressing their dissatisfaction with the company (see Williams, 2009). Ultimately it is not possible to provide a definitive answer on this issue.

9.1.5. Construct validity

There are two aspects of this study related to construct validity. The first one is related to the concept of safety culture in general and the second one to the properties of the qualitative and quantitative measures. Regarding the first, a literature review was conducted in the first instance to ensure that this research would be aligned with the established research tradition in this domain in order to maximise its potential to contribute to established insights. Furthermore, a multi-methods design was applied in order to avoid previously identified limitations attributable to mono-method bias (see Shadish, et al., 2002). The second aspect will be divided into two parts: qualitative and quantitative.

Validity of qualitative tools

A number of techniques were undertaken to satisfy the validity criteria proposed by Lincoln & Guba (1985). In order to establish the “credibility” criterion of the qualitative research (labels used originally by the authors), “prolonged engagement”, “persistent observation”, “triangulation” and “peer debriefing” techniques were applied. The first one is “prolonged engagement”. The authors suggest that the researcher should be engaged in exploring a problem for a relatively long time in order to become intimately familiar with it. In the case of this thesis, being seconded to the sponsor’s plant allowed exactly that – emergence in the context. The authors also recommend using different research methods, a process called “triangulation” (see Chapter 3), in order to enhance the findings. That was achieved by conducting individual and group interviews. Finally, reviewing the research with peer researchers, “peer debriefing”, offered additional insight into the process of research. In order to establish “transferability,” an extensive description of the results was offered (see Chapter 5). To comply with the “confirmability” standard, “triangulation” and “audit trail” (showing all steps taken in the analysis) were applied (see Chapter 5). In order to comply with the “dependability” standard, an external audit of the analysis process and of the results was conducted by academic experts (N=2). Furthermore, the “methodological coherence” (see Barret, Mayan, Morse, Olson, & Spiers, 2002) was ensuring that the research method addressed the research question directly. With regard to the appropriateness of the sample (Barret, et al., 2002), it may be argued that the individuals being interviewed on the shop floor did not constitute a representative sample of the company's employees, as they were chosen on the basis of convenience. However, the participants of the focus groups were drawn from the largest departments, and it is argued that the findings from those group discussions are very likely to represent fairly the views of general population of employees.

Validity of thequantitative tool

The validity of the safety culture questionnaire was assessed to a limited extent. The face validity / coherence of items was assessed through appraisal by and discussion with safety experts – members of the sponsor company's safety department - (N=4), academic experts (N=2) and a sample of employees during the pilot study (N=10). Content validity was further assessed by a) comparing the generated items with items of other safety surveys published in the literature, b) comparing the devised factors with safety culture dimensions reported in the literature, and c) by comparing it with safety climate and safety culture definitions.

The factor scales derived from the survey data statistically differentiated between departments and functional positions, providing some support for the concurrent validity; however, as no accident data could be linked to the survey data, it was not possible to establish whether the survey results differentiate groups according to the injury rate.

Discriminant validity (evidence that the developed measure is not related with measures it should not be related to) was not calculated due to the lack of appropriate data as measures not related to safety climate were not used in the study.

9.1.6. External validity

Questions might be raised over the generalisability of the results of the safety culture survey beyond the study organisation. The data obtained provided information about employees' concerns related to safety, its consequence on their motivation as well as morale and its distribution across departments. The findings are composed by a set of constructs that mirror those found elsewhere. However, their combination and salience relative to the other factors that other studies have found – combined with the general observation that there is notable variability between studies in the array of identified constructs - limits the utility of the findings in terms of viewing them as a set of universal constructs. Rather, these are the key constructs in this context.

9.1.7. Practical utility of outcomes

The comprehensive assessment of the company's safety culture has a number of valuable benefits. First, it offers the company an understanding of the two types of insight of employees' orientations, namely, attitudes and behaviours related to safety. The survey results offer a profile of what were believed to be a range of key variables affecting safety culture across the organisation and permitted an examination of testable differences between a range of demographic groupings, e.g. by job role or by department. The qualitative evidence provided detailed information about aspects of shared concerns and their impact on employees' attitudes and behaviour.

Taken collectively, the qualitative and quantitative insights allow the development of specific changes to address safety culture in the organization, in essence a contribution to organisational learning. Moreover, a comprehensive approach to the discovered issues may potentially improve the safety culture of the company and, assuming a linkage between culture and injury rate, reduce the number of injuries and accidents. The results offer a guide for the development of a short-term and a long-term improvement plan that in the long run could help to drive the safety culture of the company in a more positive direction.

Moreover, the results indicated that there is a strong positive and negative impact of the corporation on both the leadership and general safety in the plant. The obtained findings may help the corporate leaders to devise a strategy of reinforcing the positive impact it has and of diminishing the negative effect it has, especially on the leadership style of the company which in turn affects employees.

It is worth emphasising, however, that addressing the majority or all of the revealed problems requires substantial resources, both human and financial, and these could not have been offered by this research or the researcher himself. It was not the aim of this thesis to develop comprehensive strategic plans for the company, but to develop and apply an intervention.

9.2. Evaluating interventions

9.2.1. Overview

Due to the limited resources, not all safety-related concerns assessed by the interviews, group discussions and culture survey could be addressed. In that context it was decided to focus on a single but potentially influential factor affecting safety culture: leadership. The literature was reviewed in order to identify published interventions focused on that aspect of organisational performance. This revealed that the safety-related evidence base on changing management behaviours is sparse; however, Zohar & Luria (2003) report very positive results. It was therefore decided to attempt to replicate this technique. The method is based on upward feedback (subordinates reporting on their immediate superior). A variation was to link this with the findings of Day (2000), which highlight the merits of a broader perspective of feedback from multiple sources, i.e. the 360-degree feedback technique, widely used outside the safety domain. In order to evaluate the potential impact of the intervention a number of measures related to leaders' effects on safety culture were chosen and planned to be applied before and after the implementation of the intervention. Additionally, to measure the impact of the intervention on safety conditions and shop-floor workers an observational checklist was devised. A number of steps were undertaken to communicate the incoming initiative, including poster communication, meeting with management and discussions with blue-collar workers. The management and shop-floor workers agreed to participate.

The mechanism on which this intervention relied were the principles of cognitive bias, which assigns greater weight to short-term results (e.g. time gained after a shortcut or PPE-related discomfort) than long-term (e.g. longer exposure to the hazard) when choosing alternatives for behaviour (Barron & Erev, 2003). The unsafe behaviour, which infrequently and rarely causes injuries or accidents, immediately reinforces the unsafe behaviour. The managerial task is to outweigh these benefits. Zohar & Luria (2003) suggest using short-term rewards as a part of the ABC (Antecedents-Behaviour-Consequences) framework.

Zohar's approach is based on the behavioural approach that suggests modifying antecedents and consequences in order to modify particular behaviours. However, he innovated by claiming that the antecedents and consequences for shop-floor workers can be delivered by supervisors and that, in order to engage them, middle managers must play a similar role by providing relevant antecedents and consequences. Zohar also claims that these safety-related supervisory behaviours are a key influence in defining the safety climate, which in turn is related to the rate of micro-injuries (Zohar, 2002a).

Despite attempts to enhance ownership of the intervention amongst supervisors and shop-floor workers (see Chapters 7), after the second week of the intervention the shop-floor employees ceased to complete feedback forms and, as the intervention was based on their feedback, it had to be stopped.

The discrepancy between the success of Zohar's study and this one was significant. Despite following most of Zohar's recommendations, the intervention failed. It was decided to explore this discrepancy. To this end a sample of shop-floor workers and supervisors were interviewed and the findings were discussed with a panel of experts (safety practitioners) who had extensive practical experience and theoretical knowledge of the subject.

Four intervention participants agreed to discuss their experience with the implementation process: two supervisors and two shop-floor workers. They indicated that low trust towards managers and the researcher, their role definition, face validity, negative past experiences, non-transparent communication and alienation were the factors that affected their motivation to participate.

Furthermore, the interviews with experts coming from a variety of backgrounds, including academics, internal safety managers, external safety consultants and leadership coaches suggested that more factors ought to be taken into consideration before the implementation of any program than Zohar's study suggested. These included a strong recognition of leaders' motivations and contextualising the intervention. The experts suggested a number of practical steps to apply before and during the intervention, including the types of questions to ask, the content of the training sessions and meetings, ways of auditing safety and culture, and the best ways to cooperate with junior management and shop-floor workers (for a full review, see Chapter 7).

Following the lessons learned from the failed intervention and experts' advice, supported by the relevant literature on the need to merge new change programs with the pre-existing working style in companies (see Chapter 8), it was decided to make an attempt to develop a second intervention in a different department. The research design was similar to the previous one: pre-test / post-test evaluation with the inclusion of a control group, using the same efficiency assessment methods. However, the intervention mechanism was different this time. Although still focused on leadership, it used a pre-existing company tool used to ensure supervisory compliance with the required production-related tasks. The tool - called Standardised Work for Leaders - was extended by safety elements focusing on interactions about safety between supervisors and shop-floor workers. The intervention lasted six months and the observational measure indicated a significant improvement of safety performance during the intervention compared to the baseline ($p<.05$, $\omega^2=.28$). However, it is debatable whether the improvement may be attributed to the intervention itself, as supervisors followed the agreed instructions to a minimal extent. Moreover, at the same time a production-focused intervention was being applied in the experimental group. With regard to success measures, only one additional safety citizenship behaviour resulted in significant improvement ($p<.05$, $r=.31$) after the intervention compared to the baseline. The intervention did not result in the improvement of safety climate, neither at the organisational nor group level.

Zohar's intervention is unique in the sense of applying a very structured approach to the behaviour modification of supervisors. This approach stands in opposition to methods dominating the field, which are focused more on general leadership development rather than on strictly changing certain types of behaviours (see Lyons, 2006; Ryan, 2008; Van Velsor, McCauley, & Ruderman, 2010). The leadership development programs are more generic, focused on improving skills and knowledge and on developing self-awareness in the relationship with co-workers. They also usually take a long time to complete or are only based on one-off event e.g. classical 360-degree feedback (*ibid.*). Moreover, the majority of such programs are targeted at middle and junior managers (*ibid.*) and not supervisors. The supervisors, in most cases, receive training on specific skills. Behavioural analysis is also applied to the management representatives, as suggested by Krause (2005), but no paper was found by the researcher describing the application and evaluation of that method.

9.2.2. Barriers to implementation

Although two different tools were used with every intervention (360-degree feedback and Standardised Work for Leaders) and despite the fact that the second intervention lasted six months, the implementation of both initiatives encountered some barriers - very rapid and unexpected ones for the first program and more subtle for the second one. The first intervention participants indicated that they refused to provide regular feedback because they felt threatened by a combination of elements. Concerns over being identified and punished for expressing opinions about management dominated the conversation. Participants felt that they could be identified on the basis of their opinion. In small groups working together for a number of years all group members know who holds particular attitudes. Therefore participants were convinced that they do not have to put their name on the forms to be recognised; it was enough to see their scores. Additionally, they did not trust the researcher to keep the feedback forms safe, as they had trusted external consultants in the past and had been disappointed. They also felt disappointed by the management and preferred avoiding any engagement to avoid a repetition of the past. They also did not clearly understand what this intervention was for and were afraid it may have a detrimental effect on their work. Unfortunately the intervention also took place during the redundancies process, which reinforced fears over being made redundant. In their perception it was better not to risk expressing any opinions about the management. These were very contextual variables specific to their department.

The second intervention, which took place in a very different operational unit, had a dissimilar profile and so the barriers were different. The initiative in the cleaning department did not directly engage shop-floor workers but was more focused on close cooperation between supervisors and a manager. The direct obstacle to the implementation process was the attitude of supervisors, who pledged their support and cooperation but did not keep their promises. It created a serious challenge for cooperation, as every week they provided a number of reasons explaining their lack of engagement and insisted that next week everything would go according to the plan. This impasse lasted for the whole period of the intervention. In theory their manager should review their progress with the supervisors, but although he tried, he was unsuccessful. The main argument provided by supervisors was the lack of time and pressure to focus on other things. However, it was noted that they also struggled to follow up with other elements related to production processes from their standardised list. There were a number of hypotheses for why this happened and they are discussed in detail in Chapter 8.

9.2.3. Alternative strategies

With regard to changing the improvements of the intervention programs, they could benefit from providing training to supervisors and managers on interacting with shop-floor workers - specifically, on how to give positive feedback without embarrassment and how to provide negative feedback without blame or aggression. A number of training types could be considered, but possibly the one based on role play could be very relevant to this situation (Bell & Kozlowski, 2008).

With regard to the safety interventions in general the number of alternative interventions was infinite. A number of other elements of the assessed safety culture could also be addressed. However, the main point supporting the chosen interventions stems from research showing that leadership has the biggest impact on safety culture.

However, based on the knowledge and experience developed during the three years of this doctoral studentship, the researcher would approach the whole intervention differently. Instead of finding a method in the literature, an in-depth interview with the plant manager and corporate safety directors would be conducted in the first instance to understand their priorities and needs as well as the interpretive framework that they apply to create the meaning of the current situation. Understanding their top three priorities and their relevance to safety would be the most important basis for the development of intervention foundations. Following that, an informal conversation with a sample of employees from different departments and functional positions would be held to probe their past experiences, level of trust towards management, strength of estrangement, communication and safety needs. A relationship with the Union would be established very early to understand their past experiences in change implementation programs. However, the next steps would strongly depend on the findings. It could be coordinating groups responsible for particular safety-related projects or improving safety policies, focusing on the three main behaviours responsible for the majority of injuries or executive coaching. The answer to what has to be improved and how would directly depend on the context of the company.

Furthermore, behavioural analysis could have been conducted to understand the antecedents and consequences that were reinforcing supervisory and managerial reluctance to follow the agreed instructions. That could have possibly helped to alter them and make the intervention more successful.

The challenges faced during the implementation of safety culture interventions are similar to other interventions in organisational settings. There is a body of literature on the subject of organisational / occupational stress and health interventions that struggle with the process of implementation and evaluation of interventions.

There are a number of papers that discuss the factors responsible for the successful implementation of health-related interventions, but similarly to the safety culture literature, there is little agreement on what is required. For example, one group of researchers (NytrØ, Saksvik, Mikkelsen, Bohle, & Quinlan, 2000; Saksvik, Nytrø, Dahl-Jørgensen, & Mikkelsen, 2002) identified four important ingredients: 1. Social climate of learning from failure, 2. Multi-level participation and negotiations, 3. Insight into tacit behaviours that could undermine interventions, and 4. Roles and responsibilities during and after the period of intervention. Nielsen, Randall, & Albertsen (2007) suggested that the participants' positive appraisal of an intervention is a determinant of success. However, the authors noted that the same intervention may be perceived differently by different employees within the same intervention group, by different groups or in different organisational settings. Biron, Gatrell, & Cooper (2010) added changing organisational context, low ownership of stakeholders and flaws in the intervention design, and Weiner, Lewis, & Linnan (2009) even developed a theory of implementation and listed even more variables, such as 1. Organisational readiness for change, 2. Implementation policies and procedures, 3. implementation climate, and 4. fit with values.

Jointly with the variables affecting intervention implementation identified in this thesis, this gives a long list of things to consider. Analysing the list of factors supporting the effective implementation of organisational change, it may be concluded that there is no agreement regarding the factors. Every study highlighted a different set of variables. All the variables listed in the health-related literature differ from the variables identified in this Ph.D. thesis. There are a number of possible reasons for this. As this Ph.D. research demonstrated, context is of crucial importance, shaping the process of implementation and possible outcomes. Therefore, as all of the aforementioned studies were conducted in different organisations, the process of implementation and barriers were potentially different. If the details of context affect the intervention implementation, it may not be possible to develop a blueprint of instructions discussing how to implement and intervention in any organisation. An alternative explanation is that there is no developed theory of intervention implementation that could help with the interpretation of the process of implementation. Yet another explanation may refer to the limitations of the evaluation process. If qualitative methods are used, then the analysis is conducted on words and meanings shared by the interviewees, which will differ between different groups. If that was the case, possibly a large number of studies could help with identifying variables common to the majority of studies. That could also help in the development of a theory.

However, independently of the aforementioned explanations, there is another limitation to the aforementioned studies and identified barriers to implementation – the usefulness of this knowledge in the process of the implementation. The list of the variables affecting the process of implementation appears to be a list of ‘what’ to do, not ‘how’ to do it. For this reason practitioners could potentially ask in what way having that list of variables could help with the implementation. The answer could be: by addressing these variables. But this answer still does not suggest how to address them. The community of researchers has recognised the need for developing ‘how’ and the description of many attempts have been offered mainly through suggestions on how to advance the process of evaluation of intervention and decode the so-called ‘black box’ and focus on the process rather than on the outcome. Cox, Karanika, Griffiths, & Houdmont (2007, p. 353) defined process as “the flow of activities; essentially who did what, when, why and to what effect”. However, the current attempts to describe ‘how’ are still describing ‘what’. For example, Nilsen (2007), in an attempt to describe ‘how’ to implement interventions, suggests a process that includes securing resources, delivering programme components, ensuring exposure to the programme and including the context. However, the process suggested by Nilsen appears to be a list of different variables, suggesting ‘what’ rather than ‘how’.

Two different studies used process evaluation techniques better to understand why interventions succeed or fail. Nielsen, Fredslund, Christensen, & Albertsen (2006) tried to understand why the same intervention applied in different working groups resulted in different outcomes. The authors used mixed-methods research to evaluate a health improvement intervention in Dutch canteens. The reasons they found were very contextual and specific to different groups. Some reasons for failure pointed out by the researchers were related to the confusion of roles and responsibilities, lack of cooperation between the two canteens, replacement of the leading project manager, organisational changes unrelated to the intervention, change fatigue, conflicts between employees, other ongoing interventions, different leadership styles of canteen managers, and limited management support. Furthermore, on the basis of the interviews they conducted, they questioned whether the observed changes were due to the intervention itself or to managers who wanted to initiate similar changes anyway.

The authors indicated that they listed the most important barriers, suggesting that there were other elements affecting the process not described in the article. If the researchers had known about these barriers before the implementation of their intervention, would this have prevented it from happening? This is a very important question about the potential usage of knowledge about the implementation barriers. If they had known that there was a conflict between employees that consumed a lot of energy and attention, would they have been able to remove it? This is a somewhat rhetorical question without an answer, but it highlights a very important problem – how to use the information from the research. The translation of ‘what’ into ‘how’ may be potentially the biggest challenge for the scientists investigating the effectiveness of intervention implementations. In that sense the results of the research in the health-related arena are similar to the results of this Ph.D. study. Even the attempts to understand the barriers preventing the implementation success do not provide answer on ‘how’ to prevent it from happening in the future. From the experience of the researcher it may be worth exploring the skills that the change agent must demonstrate in order to be successful, but that would be a major change in the paradigm.

9.2.4. Efficiency measures

Furthermore, it would be ideal to link the behavioural observations of individuals with their safety climate and other related scores. That would allow the elucidation of the relationship between safety perceptions and behaviours. However, it could not be done due to the anonymity rule for occupational survey research (Campbell, et al., 2009).

Also, with regard to alternative methods that could be used, there are plenty of them available in the subject literature. However, Zohar’s method was chosen as it solely focuses on leaders as a source of climate and refers to very specific behaviours that shape climate. Therefore it was argued that it would be the most relevant and sensitive method in the context of implementing an intervention focused on supervisory behaviours. There could also be other methods used in addition to LMX and safety citizenship; however, that was limited by the administrative constraints such as the limited time of employees off the shop floor.

Additionally, individual interviews could have been conducted with the participants of the second intervention in order to test the hypotheses about the lack of engagement of supervisors and managers and possibly gain additional understanding of the processes hidden from the researcher.

Additional feedback from shop floor workers could also have been gathered in order to reflect the frequency of supervisory interactions with workers. However, there was an inherent risk involved that the blue-collar workers would behave similarly to the participants of the first intervention and refuse cooperation.

9.2.5. Limitations

Except the limitations related to the measurement tools described in the previous section of this discussion, there are a number of reliability concerns linked to the observational measure. Due to the lack of resources the inter-rater reliability could not be calculated and so the observational list was only assessed with regard to face validity.

9.2.6. Threats to internal validity

Campbel & Stanley (1963), Campbel (1969), and more recently Shadish, et al. (2002) offered an extensive discussion of the threats to the internal validity of interventions and some of them may be relevant to the second intervention described in Chapter 8. First, due to the constraints in selecting samples for the experimental and control groups, it may be argued that the qualities of individuals engaged in the intervention (blue collars) differed in both interventions in both groups and that difference was not controlled for. Furthermore, both groups had different leaders (supervisors and managers) and, as was demonstrated, it is the leaders who are responsible for shaping the culture that becomes a frame of reference for behaviours (Schein, 2004).

Furthermore, during the second intervention in the experimental group there were other improvement programs being implemented, with special attention paid to production flow, which is likely to have affected not only the production but also housekeeping (see the discussion in Chapter 7).

9.2.7. External validity

The generalisation of the findings is substantially constrained by the contextual factors that played a strong role during the process of implementation and affected internal validity: low motivation of supervisors, redundancies, using a pre-existing management tool and the implementation of lean manufacturing. The combination of these elements limit the generalisability as it is unlikely that any other company would be in a similar situation. Furthermore, the small sample - two supervisors and one manager - does not allow generalisation.

9.3. Interpretation

The insights about the implementation process and the inquiry into the perspectives of intervention participants add valuable knowledge about the importance of context during the application of a change intervention. That is even more important in the light of the limited understanding of the process of implementation published in the literature. Papers describing safety improvement interventions offer limited insights into *why* what they did worked (e.g. Donald & Young, 1996; Fitzgerald, 2005; Rasmussen, et al., 2006). Moreover, as the word limit for scientific publication is restricted, it is not possible to tell the full story and describe the majority of the contextual variables affecting upon the effectiveness of the intervention (*ibid.*).

The results of this research address these limitations. First, it allows a more comprehensive description of the context, which is additionally enhanced by the researcher’s presence in the sponsor company. It also helps to understand why the majority of change programs fail. Smith (2002) analysed 48 different types of change programs and concluded that the median success rate was 33%. Vinson, Pung and Gonzalez-Blanch (2006), on the basis of data from 1536 executives, concluded that fewer than 40% of attempts to introduce performance improvement programs were successful. These data show that despite six decades of research on organisational change (see Bridges, 1980; Jannsen, 1982; Lewin, Cartwright, & Argyle, 1952; Musselwhite, 2004; Spencer, 1990), the process of implementation has not been mastered. Additionally, there is still a lot of confusion with regard to establishing what works and why, as there is very little agreement on what predicts a successful change (Anderson & Anderson, 2001; Cummings & Manring, 1977; Kotter & Cohen, 2002; Olive, O'Connor, & Mannan, 2006).

What this study shows is that the context is everything. The first unsuccessful intervention helped to understand what went wrong; the second strongly suggests that a multitude of improvements going on at the same time may influence the internal validity of any intervention. Each organisation has a unique history, properties that are temporal and stable in time, unique policies and procedures, and unique leadership. Even though the majority of studies suggest the crucial role of management engagement, contextual factors (like aging hourly workmen, as shown by Sim & Rogers, (2009)) may overburden even the most engaged management. Therefore it is argued that (a) understanding the subjective motivators of the workforce and (b) addressing related issues may be the main drivers winning the hearts and minds of employees. Obviously, the skill to listen and manage these difficulties is no less important.

That above general conclusions stemming from this study appear to be supported by the recent study of McKinsey (Keller, Meaney, & Pung, 2010) on the sample of 2512 executive directors. The results indicate that, according to the senior managers, engaging employees collaboratively throughout the company and for the whole period of transformation was one of the most important predictors of success. Another predictor was related to the capabilities of leadership, who pay attention to personal concerns of employees, can recognise their mind sets and focus their attention on strengths rather than problems. The advantage of that study is the impressively large sample of executive directors, not often achievable in scientific studies. The limitation is that it was based on the subjective perceptions and not subject-independent evaluation. Nevertheless, their results are consistent with the recent evaluation of the effectiveness of 17 safety improvement projects in 29 companies in the Netherlands (Hale, Guldenmund, van Loenhout, & Oh, 2010). Their results indicated that the most successful companies ensured the constructive dialogue between blue-collar workers and management, provided motivation to middle managers and strengthened learning loops in the safety management system.

However, a question arises in that context relating to behaviour-based interventions. They rarely consider the opinions of blue-collar workers and focus strongly on managing resistance to a new program (Hopkins, 2006), despite the fact that the research shows that this approach is quite effective (Krause, 1999). There are a number of possible answers to this question. First, there is international, intercultural variability in what people accept as standard. That point was indicated by one of the experts with experience of managing safety at sites in different countries (see Chapter 8, Study 2). Although research on applying the same intervention in different cultures is not known to the researcher, it may be possible that the culture of the U.S.A., where the majority of BBS programs are implemented (Krause, 1999), is different to the culture of the UK or other countries. Therefore, on the basis of the available evidence, we know that BBS programs are effective in the U.S.A. but we do not know about other countries. Furthermore, it is unknown what percentage of companies in which the BBS program failed declined to take part in the study. That questions the validity of the evaluation studies, as it is argued that the evaluation is based only on successful studies.

Having a change method is not enough. There are a number of other factors that affect implementation and these must be known beforehand. This research helps better to understand what these factors are.

9.4. Practical significance of the outcomes

As the generalisability of these findings is very limited the results are significant mostly for the sponsor company. The first intervention study offers a number of themes that must be addressed in order both to: implement any new improvement intervention and improve cultural elements, allowing an increasingly mature response to safety management concerns. Moreover, it offers a step-by-step instructions on how to implement a program. The second study offered the understanding that having a method for change is not enough to engage key players if there is no internal motivation to participate. The conclusion from these findings is that the first stage before implementing any program at the middle-management level and below should be preceded by the in-depth analysis of the contextual factors, including personal motivators.

The ANOVA analysis between functional positions showed that the perception of shop-floor workers differs from the perception of supervisors and that the perception of supervisors was more in line with the perception of managers. In Chapter 7 the regression showed that job insecurity predicts a more negative perception of the safety engagement of supervisors but not of top management.

Maybe that is because job security affects supervisors as well; they focus more on production and spend less time on safety and that is clearly visible for workers whereas actions and behaviours, policies etc. do not easily change with redundancies. Therefore in times of redundancies even more effort should be expended on safety.

9.5. Further Research

The studies in this thesis revealed a number of areas that need further empirical investigation. The literature review identified the following areas requiring additional research:

- The analysis of the behaviours of supervisors and managers showed that the behaviours of supervisors are much better understood than those of managers, so further research should focus on better understanding specific managerial behaviours and their impact on safety culture.
- The analysis of safety culture interventions indicated that safety culture may be improved by providing training to senior leaders in transformational leadership (Mullen & Kelloway, 2009), so further research should focus on what type of training should be given to which groups, and under what conditions it is the most effective, as well as, in what national cultures it works and at what levels of safety culture maturity.
- The conclusions of the first chapter suggest that safety culture research does not analyse the underlying assumptions and language as the researchers of organisational culture do, so this is another area for future research.
- It remains unclear what mechanism underlies the linkage between safety climate and behaviours / injuries and whether the impact of safety climate is direct or mediated by other elements.

The failure of the first intervention helped to understand what was blocking employees' motivation to participate, but it did not provide insight on how to change it, although the interviews with experts shed some light on the process of "how" more research is needed in order to establish:

- How to build or recover trust between managers and blue-collar workers.

- How to develop trust between blue-collar workers and a change agent.
- How to redesign / modify role definitions held by employees.
- How to overcome negative expectations stemming from past negative experiences with change programs.
- How to communicate successfully in the context of a planned workers organisational change.
- How to overcome the negative consequences stemming from alienation.

Furthermore, on the basis of the general conclusions from this research suggesting that context is most important and that its elements should be addressed in the first instance, it is argued that further research on methods for improving safety culture should focus not on developing general tools but on developing the best methods that help deeply to understand the context of a particular company and on developing an understanding of what personal qualities of change agents and leaders at different levels of hierarchy affect employees' perceptions.

Despite the investigation into the first intervention participants' motives and into the experience of practitioners with implementing change programs, the question of whether addressing all these elements would guarantee success remains unanswered. Furthermore, it is probable that the list of variables affecting the process of implementation listed on the basis of the interviews with change participants and experts is not complete. Therefore there may be yet other factors influencing the process of implementation.

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Appendix A

Great Western Research

STUDENTSHIP PROJECT APPLICATION FORM

ID:	246
Code:	246
Date:	08/09/2006
Theme:	Psychology
Project Title:	Developing effective safety culture interventions in the manufacturing sector

THE APPLICANTS:

Host Institution:	Bath
QAA Compliant?:	Yes
Department:	Psychology
2nd Institution:	Plymouth
Department:	Psychology
Other HEI:	
External Partner:	the sponsor company
Nature of Business:	Manufacturer of high quality castings for aircraft engines
Charity?:	No
Public Sector?:	No
SME?:	No
Significant Regional Employer?:	Yes
Has a commitment in principle been obtained,	

and forwarded, from the lead partner?:	Yes
2nd External Partner:	
Name &Address:	
Nature of Business:	
Charity?:	No
Public Sector?:	No
SME?:	No
Significant Regional Employer?:	No

TOTAL VALUE:

Total cost of studentship (£)	55200.00
Total contribution from external partner(s) (£)	27900.00
Explanation if less than 50%	
Additional contribution (amount and source) (£)	0.00
Total required from GWR (£)	27300.00

THE PROJECT

Proposed Start Date :	01/12/2006
Proposed Finish Date :	02/12/2009

Project Description:

Developing safety culture interventions in the manufacturing sector.

Aim

To play an active role in assisting the company to develop and implement effective workplace health and safety climate improvement interventions.

Objectives

To gain a detailed insight into variables that impact upon health and safety culture at the company. To conduct a comprehensive review of the published literature and expert understandings of successful workplace health and safety interventions. Based upon an assessment of health and safety culture at the company; published findings and expert insights, provide advice and hands on assistance to the safety department to develop a bespoke set of interventions for the company. Develop measures for monitoring the effectiveness of safety climate interventions developed at the company. Provide an account of the intervention process and associated organisational learning.

This applied study will explore latent influences on employee risk taking and risk management practice at the Sponsor Company. It will focus on developing sustainable risk management interventions, designed to bring about a measurable improvement in health and safety culture and reductions in work related ill health and accidents. It will build upon established insights from the safety culture / safety climate paradigm and broader insights from the organisational change and behavioural intervention literatures. To date, there have been very few rigorous studies that focus on how organisations go about developing interventions that enhance safety culture. The majority of academic activity in this area, while offering valuable insights into a range of variables said to define and impact upon safety culture, offers rather less on how and in what ways these variables are important. Insight at this level is needed before moving to the stage of developing and applying effective safety culture interventions.

Work related ill health and occupational accidents constitute a significant cost to individuals, their families, employers and the wider community; moreover their reduction is a key component of the Government's public health and social exclusion agendas. (For further details please refer to 'Securing Health Together', Health& Safety Commission (HSC), July2000)

The twentieth century witnessed major advances in standards of workplace health and safety, principally through material improvements in working conditions and the design of intrinsically less hazardous systems of work. Many safety professionals, academic researchers and the workplace health and safety regulator (HSC/E) consider that benefits from this approach have plateaued (Kennedy, 2004). As a consequence, over the last two decades, there has been an increased focus on employee behaviour, in particular aspects relating to non-compliance with safe practice and volitional risk taking.

Largely due to the applied nature of the research need, i.e. real world (workplace) solutions, the focus for psychological research in this area has not been on exploring individual differences, but upon social and cultural influences on employee behaviour. Individual difference research in this area has been effectively abandoned, due to the overwhelming evidence of the greater salience of social and cultural influences (Royal Society, 1992).

What has become known as the 'safety culture / safety climate' paradigm focuses on normative influences on behaviour, specifically the "…beliefs, norms, attitudes, roles, and social and technical practices that are concerned with the exposure of employees, managers, customs and members of the public to conditions considered dangerous or injurious." (Turner et al 1989). The key premise here is that though gaining an understanding of those variables that define and influence safety culture, workplace interventions can be developed that will engender change and improvement

Understanding which variables are important and how they impact on behaviour in a given organisational context requires a probing and exploratory approach. Interventions designed to enhance health and safety performance also need to be culturally relevant and of good fit with the organisational context (Weyman et al 2003 & 2006).

Psychometric techniques have been widely applied in this area, with the purpose of discovering the universal set of variables that impact upon safety culture and climate. This somewhat theoretical body of work (Royal Society 1992) has reached a level of maturity and consensus over a range of constructs, including: leadership style, management commitment; practicability of rules / procedures and openness / blame (see Cox & Flin, 1998; Collins, 2002). Beyond these, notable viability has been found between organisations, both with regard to the constructs identified and the manner in which they operate. This finding highlights the need for research methodologies in this area to be focused on exploring contextual influences, particularly where the research aim relates to organisational interventions (Weyman et al 2006).

The proposed study will build upon insights from previous safety culture work undertaken by Dr Weyman, in particular work in the mining industry and the railways sector. In the first instance a combined -qualitative and quantitative - methods, approach will be used to develop a detailed contextual insight into variables that impact upon and define the safety culture(s) at the sponsor company, and their relative strength. It is envisaged that this activity will involve individual depth interviews and

/ or focused group discussions with a cross section of personnel, as a precursor to the development of a staff survey measure. The latter will provide a benchmark of current performance and identify points of strength and weakness, and act as a point of comparison for assessing change over time. This data will also provide the initial basis for the consideration of interventions options. Formulation of the interventions themselves will draw upon published evidence of effectiveness and the review of expert / practitioner insights, combined within insights from the contextual data gathered at the sponsor company.

An action research approach is envisaged, with the researcher embedded within the company safety department. The researcher will actively participate in the change process, by gathering qualitative and quantitative evidence to inform managerial decision-making, via the safety department, while at the same time gathering principally qualitative data on the organisational dynamics that surround the change process. In essence the sponsor company will go through a process of characterising and benchmarking its current practice, identifying salient influences on health and safety behaviour, devise and implement a bespoke set of intervention measures and monitor their effectiveness.

The principal output from this research will be a detailed insight into and account of how work organisations might go about tacking safety culture issues, in particular the process of organisational learning associated with developing and implementing successful in-house interventions, i.e. what works and how do you make it happen. Findings from this research will be of relevance to industry, health and safety professionals; workplace regulators and academics.

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Jeffcott, M; Weyman, AK; Pidgeon, N. F. & Walls, J Reflections from an Investigation of Safety Culture in Train Operating Companies Submitted J of Risk and Society In press

Kennedy, J Rt Hon Minister of State for Work (2004) Health and Safety Commission open meeting http://www.aboutus/hsc/meetings/2004/121004/jnennedy.pdf

Royal Society Report on Risk Analysis Perception and Management. Royal Society. London.

Weyman AK; Pidgeon, NF; Jeffcott, M & Walls J (2006) Organisational dynamics and safety culture in UK train operating companies. Health & Safety Executive Research Report. RR421

Weyman A.K., Clarke, D.D. & Cox, T. (2003) 'A factor model of risk taking in UK Coal mines' Work & Stress; December.

Project Abstract:

Developing effective safety culture interventions in the manufacturing sector.

Workplace accidents and work related ill health negatively impact upon on the well-being of employees, their families and the wider community; impose costs and resource burdens on local health and social care services; and can threaten the future viability of employing organisations. Workplace accidents and ill health have been calculated to cost employer's an average of£741.00 per employee per day.

This study is about finding innovative ways to reduce employee risk taking at work and, by implication, the incidence of accidents / ill health and associated costs. Organisational psychologists from the universities of Bath and Plymouth are working with a local manufacturing company, providing expertise on human behaviour and behavioural change. The focus for this work is on developing initiatives that bring about measurable, sustainable improvements in workplace safety culture. A successful outcome will provide the opportunity for the participating business to become as a flagship organisation and exemplar of good workplace risk management practice for the region. The findings from this research will provide valuable insights to employers and health and safety practitioners, on effective strategies for reducing risk taking at work. It is intended that the findings from this work will be publicised across the South-West region using established knowledge transfer networks and business forums. It is also intended that the findings will be published in internationally recognised peer reviewed journals.

Alignment with proposed theme:

This proposal talks to the theme of psychology, specifically the applied organisational psychology of workplace safety culture / climate.

Notable debate exists over what is meant by the concepts of safety climate and culture, the extent to which they can be considered discrete, as well as over the range of variables that engender positive or negative influence (see Cox & Flin, 1998). With regard to those variables thought to impact upon organisational safety culture/climate, insights from previous research exhibit notable variability. However, there is almost universal agreement over the centrality of 'senior management commitment'. Other identified effects relate to: ‘leadership style’; 'supervisor commitment'; 'levels of workforce involvement; poor communication and feedback'; 'attitudes to hazards', ‘performance pressure’; 'staff roles / responsibilities', 'compliance with rules / procedures' and the ‘prevalence of a 'blame culture'. This project will build upon the array of established insights from the safety culture / climate paradigm, taking these to the stage of developing workplace interventions, designed to bring about improvements in workplace performance.

There have been very few studies of organisational learning and the organisational dynamics associated with addressing issues of safety culture. This issue was a key focus of recent safety culture work in the railway sector (Weyman et al, 2006) and is also the focus for HSE funded work on the introduction of work related Stress Management Standards (Cox et al, ongoing). The action research approach proposed for the current study will aim to provide a richly patinated insight into these issues.

An important theoretical issue in this area surrounds tensions between approaches focused on identifying universal latent constructs and, the smaller number of, more recent studies that have emphasised the need to take account of the cultural uniqueness of organisations. In short, the majority of studies to date have been 'top-down' and, as a consequence, have been said to be methodologically a cultural. Further evidence of the need to take account of the specifics of organisational context is provided by the fact that while as many as 500 UK organisations are known to have used generic, off-the-shelf, psychometric staff survey measures, it seems that their safety culture initiatives tend to stagnate following analysis of the survey results. The use of generic question sets not only appears to limit the degree of contextual insight but, if used in isolation, at best, restricts this to the identification of 'which' variables appear important, rather than the more salient issues of 'why' and 'in what way'. Experience has demonstrated that a detailed insight into issues of why and in what way is critical when devising appropriately framed, contextually relevant remedial interventions (Weyman, et al 2006). The combined methods approach proposed for the current study will bring the methodological benefits of a grounded approach to explore potentially important contextual variables, linked with traditional quantitative, survey based, approaches to test the relative strength of associations. Quantification is also necessary to provide a benchmark of performance and point of comparison against which to assess impact.

Nature of the proposed collaboration:

Assuming a successful application to GWR for funding, the studentship will be advertised in the national and academic press. The sponsor company will be invited to participate in the interview process, and no appointment will be made unless all panel members are satisfied that the selected candidate possesses the necessary skills and aptitude to undertake the work. It is envisaged that the researcher employed on this project will be based, for at least two thirds of the three-year study period, at the sponsor company site. A high level of contact between the researcher and the sponsor company is considered essential in view of the subject matter and proposed methodology for this studentship.

The outputs from the research and the benefits to the sponsor company will be greatly enhanced through the researcher developing a detailed insight into the organisation and its working practices. It is considered that the most effective means of achieving this would be to embed the researcher within the safety team at the sponsor company, such that he/she operates as an integral part of that team. Agreement has been secured for this approach. Although the researcher may foreseeably become involved in the general activity of safety department, particularly where this would contribute to his/her understanding of the organisation and the approach to risk management, he/she will be focused on the process of identifying and developing a range of safety culture improvement interventions.

The academic supervisors will provide direction to the researcher on the design of the interventions, performance measurement and a degree of technical support / advice to the sponsor company on safety climate and related human factors issues. There will be formal quarterly meetings between at least two of the supervisors Mr Effer, Head of Quality, and Mr Turner, Head of Safety at the sponsor company, to assess progress. This will be supplemented by contact between one or more supervisors and Mr Turner by telephone or e-mail at least once per month to assess progress.

Is the research linked with
other GWR studentship
applications?: Yes

Please outline the links with other GWR applications

Dr Hellier is a proposed second supervisor on additional GWR application \\\\\\\\\\\\\\\"Making Electronic Shared Work Spaces\\\\\\\\\\\\\\\" led by Professor Jan Noyes at the University of Bristol.

The supervision team have worked in the Applied Psychology field for many years and have a range of regional contacts who will enrich and help disseminate the proposed research. These include; Human Engineering Ltd (Bristol), Qinetiq, BAe Systems, DML and the Emergency Planning Society.

SUPERVISION:

Lead HEI Supervisor:	Dr Andrew Weyman
Email:	aw290@bath.c.uk
Address:	Department of Psychology University of Bath Claverton Down Bath
Contact telephone:	01225 385279

Experience of working with business:	Often (more than 3 times)

Relevant academic experience:

Dr Weyman is a Senior Lecturer in the Department of Psychology at Bath August 2006 - date. His specialist area is the psychology of risk: risk perception; risk communication; organisational safety culture and health and safety risk management systems

From1992 -2006 he was employed by the Health and Safety Executive as Principal Scientist. During this period he acted as head of the Social and

Organisational Factors Unit at the Health & Safety Laboratory (2000 -2004) and as a policy analyst / advisor in the HSE's Social Science Unit, in London.

Prior to Joining HSE Dr Weyman worked as a consultant and as a lecturer in the university sector.

Dr Weyman managed a team of six researchers as Head of the Social and Organisational Factors Unit at HSL. He has previously jointly supervised two post-doctoral and one doctoral studentship. He is experienced in collaborative working with UK universities, having previously undertaken joint projects with the universities of Nottingham, Cardiff; UEA and Manchester.

Examples of Previous Research in this area

2003 -2005 Exploring issues of safety climate in train operating companies - HSL led project in collaboration with University of East Anglia. Value £158.000.00

Weyman AK & Kelly, CJ (2000) -Risk perception and risk communication in the workplace. A review of literature - HSE Contract Research Series Report. CRR 198/2000.HSE Books, HMSO.

Duff R; Robertson IT; Phillips RA; Marsh. TW; Weyman AK & Cooper D (1998) - 'Improving safety on construction sites by changing personnel behaviour', Phase II. UMIST -HSE Contract research report series No: CRR 137/1999. HSE Books, HMSO.

Weyman AK & Dickety N ¬ Development of a behavioural safety measure to monitor workplace transport safety interventions. HSE Report Number IR/L./ERG/6/03, 2004.

Weyman AK & Marlow P - Development of a psychometric measure of manual handling safety culture for the offshore industry. HSE Report Number IR/L./ERG/2304, 2004.

O’Hara R; Dickety, NP; & Weyman, AK ¬‘Good practice in assessing workplace risks in small and medium sized enterprises’ HSE Report Number IR/L./RAS/14/02, May, 2002.

Weyman AK; Jackson JA -‘Developing behavioural benchmarking measures to asses slip and trip hazards management in the food retail sector. HSE Report Number IR/L.//ES/03/01

Weyman, AK & Anderson, M -'An assessment of the introduction of risk management systems in the UK mining industry'. HSE Report No: IR/L/EBS/98/23. December, 1997.

2nd HEI supervisor Dr Elizabeth Hellier

Experience of working
With business: Often(more than3 times)

Other HEI supervisor: Professor Judy Edworthy

Arrangements for supervision

The research student will be jointly supervised by Dr Andrew Weyman, Department of Psychology, University of Bath; Dr Hellier and Professor Edworthy Department of Psychology, University of Plymouth.

The successful candidate will have access to the usual supervision arrangements and support structures available to post-graduate research students in Psychology at the University of Bath.

Meetings between the researcher and Dr Weyman will be held fortnightly, and with Dr Hellier once a month and Prof Edworthy every two months. The researcher will also be expected to maintain regular contact with all three supervisors via e-mail, throughout the period of study.. The three academic supervisors will meet formally to discuss progress on a quarterly basis and maintain contact by e-mail or telephone at other times.

As noted elsewhere, there will be formal quarterly meetings between at least two of the supervisors Mr Effer, Head of Quality and Mr Turner Head of Safety at the sponsor company to assess progress. This will be supplemented by contact between one or more supervisors and Mr Turner by telephone or e-mail at least once per month to assess progress.

The researcher will provide written reports on progress to Mr Neil Effer, Head of Quality at the sponsor company on a quarterly basis. These reports will be submitted to Mr Turner and the academic supervisors in the first instance.

SW Economic Benefits:

Additional R&D expenditure in the region	Yes
Details:	
Helping an organisation develop a new technology or process	Yes

Details:

This proposal represents an opportunity for the sponsor company to develop and showcase regional 'best practice' in terms of the development and implementation of effective workplace health and safety management improvement interventions.

Improving systems or techniques within the region	Yes

Details:

The project as the potential to produce measurable reductions in intrinsic risk, employee risk taking and the likelihood of accidents and ill health. The sponsor company is a significant employer in the South-West region, with approximately 800 employees at its manufacturing plant. The sponsor company has well developed safety management systems and has a good health and safety record. However, like other good performing businesses it embraces its social responsibility to strive towards continuous improvement.

Priorities for improvement at the sponsor company include reductions in musculo-skeletal injuries; slip and trip related injures; injuries from being struck by moving vehicles and exposure to harmful substances. These topics are all currently priorities under the Health and Safety Executive's Revitalising Health and Safety initiative. As such work on these topics is closely aligned with central and local government health and safety regulatory priorities.

Reductions in the number and severity of injuries have transparent benefits to employees associated with the avoidance of injury and ill health and hardship for victims and their dependents. Benefits to the employer include reductions in sickness-absence payments, compensation claims and staff substitution costs. Benefits to the wider community include reductions in the burden on health and social services associated with the care of victims and their dependents as well as broader impacts on community well-being. The average cost to an employer of an employee being absence from work for a period of three consecutive days has been calculated to be £2234.00. The total cost of workplace accidents and ill health, including externalities, in Great Britain in the financial year 2001/02 was estimated to be £20.32billion (HSE 2006 http://www.hse.gov.uk/lau/pdfs/handbook.pdf).

This research will also provide an opportunity for the sponsor company to be identified as a flagship organisation and exemplar of good workplace risk management practice in the region. Publicising the learning from the sponsor company’s experience could be used to assist other employers in the region, and elsewhere, to learn by the company's experience, though, for example, local initiatives; established regional business links such as the South-West Manufacturing Advisory Service and other Knowledge Transfer Networks (KTNs). The provision of regular feedback on progress to representatives of regional Local Authority (LA) workplace health and safety inspectors and the regional Health and Safety Executive (HSE) Offices will provide an opportunity for further dissemination of the key learning points from the work at the sponsor company. As part of the Fit For work; Fit for Life and Fit For Tomorrow (Fit3) initiative HSE and LA enforcement bodies have been tasked with identifying examples of good practice for controlling musculo-skeletal; slip and trip and workplace transport risks for dissemination amongst employers. There is potential to use these bodies as a conduit to stimulate equivalent practice amongst other employers in the region. The supervisors have an established network of contact within the Health and Safety Executive and linkages with regional Local Authority workplace health and safety regulators

Enhancing information
about the SW Yes

Details:

The academic collaborators are established international leaders in their field and would expect to disseminate the findings of this research at national and international conferences and in international publications. High quality research originating in SW academic institutions and in collaboration with SW industry will enhance the reputation of the SW as a centre for excellence for safety research.

Other No

Details:

OTHER BENEFITS:

Benefits for the external partner (including potential monetary value):

The cost of work related accidents and ill health to employers is high and significant, particularly when damage to property, compensation claims, downtime and other indirect costs are taken into account. The average cost to an employer of an employee being absent due to an accident or work related ill health for a period of three consecutive days has been calculated to be £2234.00. The average cost of accidents and work related ill health to employers has been calculated at £148.00 per employee per annum (source HSE INDG355 03/02).

Minor accidents

Even minor accidents can have significant financial implications for employers –in terms of lost production, investigation costs, compensation claims etc. The cost of minor accidents can add up over a year. The HSE offers case study examples of minor accident costs amounting to 37% of profits in one company; in another, 8.5% of tender price; and in a third 5% of running costs (HSE 2004).

Major and fatal accidents

Major accidents resulting in fatalities or serious injuries can impose a high cost on businesses - this can sometimes amount to six or seven figure sums. By way of illustration: the following example, again provided by the HSE, relates to an accident where an employee sustained a broken limb, and the company was prosecuted under the Health & Safety at Work Act 1974:

Wages for injured employee £10,000

Disruptions to production £8,000

Additional over time payments £3,000

Wages for replacement employee £7,000

Managerial lost-time £4,000

Legal expenses &court costs £3,000

Fines under HSWA £4,000

Rise in liability insurance premium £6,000

Total cost to the employer £45,000.00

Uninsured losses

With a few exceptions, all employers need to have liability insurance, to cover injuries and ill-health sustained by their employees. Insurance policies do not cover ALL of the costs of accidents. Insurance protects employers from large compensation outlays, but many indirect costs are not covered. The cost of uninsured losses varies by type of business and type of incident, but is generally accepted as exceeding the insured sum. The average uninsured loss for an employee sustaining a lost-time accident or ill health has been calculated to be £2,097.00 (source HSE INDG355 03/02).

Major accidents can also lead to corporate reputational damage, which can have negative implications for future profitability. Where corporate or personal failures lead to major accidents, legal action may be taken against individuals and companies for manslaughter. It is foreseeable that there will be changes in the law in this area in the near future, as outlined in the draft Corporate Manslaughter Bill, March2006.

As noted elsewhere the financial benefits associated with this research relate to direct benefits to the sponsor company, arising from reductions in accidents and ill health and associated losses. Reductions in accidents / ill health have the potential to contribute to the long-term viability and sustainability of the company. Benefits to other employers in the region will arise from the dissemination of information on ‘what works’ when introducing behaviourally based workplace risk reduction measures. The take up of good-practice based on the sponsor company experience has the potential to bring equivalent gains in terms of profitability and sustainability in other regional businesses.

In summary, direct benefits to the sponsor company is arising from the introduction of behaviourally based safety culture interventions include:

Reductions in sickness-absence payments, Reductions in compensation claims

Reduced staff substitution costs

Reduced down-time

Increased profitability - and associated implications for future sustainability and / or growth.

Reduced likelihood of a fatal or serious incident -including potential costs of damage to plant and infrastructure and damage to reputation as an employer.
Enhanced corporate profile and prestige -this research will provide an opportunity for the sponsor company to act as a flagship organisation and exemplar of good workplace risk management practice in the region.

Has the partner worked
With the HEI sector
previously? No

Details:

Potential for future research collaboration

The sponsor company in a medium to large scale employer. The company produces high grade cast metal components for the aeronautical industry. It uses cutting-edge technology in its manufacturing processes,

e.g. lost-wax casting techniques. The maintenance of exemplary quality in its production processes and its products is an essential feature in the manufacture of safety critical components. In view of the size and breadth of activity undertaken at the company, it is felt that there exists considerable scope for future collaborative work with this industrial partner, in a range of spheres.

A more complete picture of the potential scope for future collaboration will be possible as understandings of the activity of the organisations are revealed during the course of the proposed research project.

Based upon current insights it would appear that the cutting-edge work undertaken by this organisation would offer opportunities for collaboration in developing and improving manufacturing technologies; metallurgy and other materials technologies; aspects relating to quality systems as well as ergonomics aspects of task design and manufacturing processes.

Appendix B

Table B1. A list of papers that describe the process of finding factors of safety culture analyzed by meta-research studies in order to find common indicators of safety culture

		(Seo, et al., 2004)	(Clarke, 2000)	(Flin, et al., 2000)	(Farrington-Darby, et al., 2005)	(Wiegmann, et al., 2004)	(HSE, 2005b)
1.	Zohar (1980)	x	x	x			
2.	(Brown & Holmes, 1986)	x	x	x			
3.	(Cox & Cox, 1991)	x	x	x			
4.	(Dedobbeleer & Beland, 1991)	x	x	x		x	
5.	(Niskanen, 1994)	x	x	x			
6.	(Coyle, et al., 1995)	x	x				
7.	(Diaz & Cabrera, 1997)	x	x	x			
8.	(Williamson, et al., 1997)	x	x	x			
9.	(Cheyne, et al., 1998)	x	x				
10.	(Mearns, Flin, Gordon, & Fleming, 1998)	x	x				x
11.	(Brown, et al., 2000)	x			x		
12.	(Cox & Cheyne, 2000)	x			x		
13.	(Lee & Harrison, 2000)	x					
14.	(Glendon & Litherland, 2001)	x					
15.	(O'Toole, 2002)	x					
16.	(Mearns, et al., 2003)	x					
17.	(HSE, 1997)			x	x		
18.	(Cooper & Philips, 1994)		x				
19.	(Hofmann & Stetzer, 1996)		x				
20.	(Cox, Tomas, Cheyne, & Oliver, 1998)		x				
21.	(Donald & Canter, 1994)		x	x			
22.	(Alexander, Cox, & Cheyne, 1995)		x	x			
23.	(Lee, 1998)		x	x			x
24.	(Rundmo, 1992)			x			

25.	(Ostrom, Wilhelmsen, & Kaplan, 1993)	x			
26.	(Budworth, 1997)	x			
27.	(Mearns, Flin, Fleming, & Gordon, 1997)	x			
28.	(Carroll, 1998)	x			
29.	(Phillips, Cooper, Sutherland, & Makin, 1993)	x			
30.	(Janssens, et al., 1995)	x			
31.	(DePasquale & Geller, 1999)		x		
32.	(Elzer, Kluwe, & Boussoffara, 2000)		x		
33.	(Lingard & Rowlinson, 1997)		x		
34.	(Pidgeon, 2001)		x		
35.	(Reason, 1997)		x		x
36.	(Simard & Marchand, 1997)		x		
37.	(O'Dea & Flin, 2001)		x		
38.	(Cooper, 2000)		x		
39.	(Geller, 1997)		x		
40.	(Van Vuuren, 2000)		x		
41.	(Cullen, 2001)		x		
42.	(Hale, et al., 2003)		x		
43.	(Fleming, Flin, Mearns, & Gordon, 1996)			x	
44.	(Flin, et al., 2000)			x	
45.	(Gordon, et al., 1996)			x	
46.	(Meshkati, 1997)			x	
47.	(Yule, Flin, & Murdy, 2001)			x	
48.	(Zohar, 2000)			x	
49.	(Eiff, 1999)			x	
50.	(DePasquale & Geller, 1999)			x	
51.	(Reason, 1990)			x	
52.	(HSE, 1998)				x
53.	(HSC, 2001)				x
54.	(HSE, 1999)				x
55.	(HSC, 1997)				x
56.	(HSC, 2003)				x
57.	(Fleming, 2001)				x
58.	(HSC, 1993)				x
59.	(Guest, Peccei, & Thomas, 1994)				x
60.	(Clarke, 1998)				x
61.	(HSE, 2003a)				x
62.	(HSE, 2003b)				x

Table B2. Categorised supervisory behaviours identified in the subject literature

Category	Sub-category	Behaviours	Reference
Leads by example		Shows a model to obey safety rules	(Wu, 2005)
		Encourages safe working by setting a good example	(Fleming, 1999)
		Cares about safety more than the average worker	(Mearns, Flin, et al., 2001)
		Pays less attention to safety problems than most other supervisors in this company (R).	(Zohar, 2000)
		Has positive safety behaviour,	(Mohamed, 2003)
		Shows me the safe way to do the task when I carry out an unsafe behaviour	(Diaz-Cabrera, et al., 2007)
		Places worker safety as a top priority	(Thompson, et al., 1998)
Communication	Explains/ educates about safety	Helps employees to recognize the importance of safety	(Wu, 2005)
		Explains the concept of safety clearly.	(Wu, 2005)
		Uses explanations (not just compliance) to get us to act safely.	(Zohar & Luria, 2005)
		Spends time helping us learn to see problems *before* they arise.	(Zohar & Luria, 2005)
		Gives me clear instructions	(Mearns, et al., 2003)
	Discusses safety	Approaches workers during work to discuss safety issues.	(Zohar, 2000)
		Discusses safety issues with others	(Lu & Shang, 2005)
		Discusses with me what is the most adequate solution to avoid the situation happening again	(Diaz-Cabrera, et al., 2007)
		Discusses safety issues with others	(Hayes, et al., 1998)
		Encourages to share and discuss issues openly and feels	(Influencing factors – Andy's materials)
		Discusses how to improve safety with us	(Zohar & Luria, 2005)
	Provides safety vision	Draws a picture to describe a safety vision.	(Wu, 2005)
	Praises for safety behaviours	Shows his/her appreciation when employees accomplish their safety business	(Wu, 2005)
		Often praises workers' safety behaviour.	(Wu, 2005)
	Welcomes reporting safety	Says a "good word" to workers who pay special attention to safety.	(Zohar & Luria, 2005)

		Praises for working safely	(Mearns, et al., 2003)
		Says a good word whenever he sees a job done according to the safety rules.	(Zohar, 2000)
		Praise for working safely	(Cox & Cheyne, 2000)
		Praises safe work behaviours	(Lu & Shang, 2005)
		Praises safe work behaviours	(Hayes, et al., 1998)
		Modestly accepts employees' advice to improve safety.	(Wu, 2005)
		Seriously considers any worker's suggestions for improving safety.	(Zohar, 2000)
	Repeats safety importance	Welcomes reporting safety hazards/incidents,	(Mohamed, 2003)
		Is a good resource for solving safety problems,	(Mohamed, 2003)
		Very helpful if you asked for advice on safety matters.	(Fung, et al., 2005)
		Values my ideas about improving safety and health	(Seo, et al., 2004)
		Values my ideas about improving safety when significant changes to working practices are suggested.	(Mohamed, 2003)
		Often declares safety policy.	(Wu, 2005)
		Frequently communicates safety issues to employees.	(Wu, 2005)
	Consequences	Regularly provides employees with safety information.	
		I talk more about safety than productivity	(Fleming, 1999)
		Frequently tells us about the hazards in our work.	(Zohar & Luria, 2005)
		Reminds workers who need reminders to work safely.	(Zohar & Luria, 2005)
		Frequently talks about safety issues throughout the work week.	(Zohar & Luria, 2005)
		Usually engages in regular safety talks,	(Mohamed, 2003)
		Keeps workers informed of safety rules	(Hayes, et al., 1998)
		When I carry out an unsafe behaviour my immediate superior tells me off and warns about a possible sanction	(Diaz-Cabrera, et al., 2007)
	feedback	Rewards safe behaviours	(Hayes, et al., 1998)
		We get feedback about our performance.	(Taylor & Thomas III, 2003)
		Studies new knowledge regarding safety continuously.	(Wu, 2005)
Develops safety knowledge		Treats employees kindly when dealing with safety business	(Wu, 2005)
Fairness		Is able to suppress his personal biases and almost always treat me fairly	(Thompson, et al., 1998)

	Considers my viewpoint when making decisions that affect me	(Thompson, et al., 1998)
	He is fair in making my job assignments	(Thompson, et al., 1998)
	Is fair on decision that affect my future promotability	(Thompson, et al., 1998)
	Sets up a harmonious atmosphere to improve relationship among employees.	(Wu, 2005)
Cares about personal issues of his group members	Is trying to solve the conflicts among employees.	(Wu, 2005)
	Is aware of how his subordinates are thinking and feeling	(Fleming, 1999)
	Protects subordinates from feeling under pressure to meet deadlines	(Fleming, 1999)
	Is sensitive to the personal problems of members of his work group	(Mearns, Flin, et al., 2001)
	Allocates safety resources fairly.	(Wu, 2005)
Allocates resources	Explicitly indicates that he/she may allocate resources to improve safety facilities	(Wu & Lee, 2003)
	Makes sure we receive all the equipment needed to do the job safely.	(Zohar & Luria, 2005)
	Audits employees' safety performance regularly.	(Wu, 2005)
Monitors/observes/ controls behaviours	Pays close attention to workers' safety.	(Wu & Lee, 2003)
	Frequently walks through the work place and understands the safe condition.	(Wu & Lee, 2003)
	Visit the worksite three or more times a shift	(Fleming, 1999)
	I carry out safety inspections with my subordinates	(Fleming, 1999)
	Frequently checks to see if we are all obeying the safety rules.	(Zohar & Luria, 2005)
	Watches more often when a worker has violated some safety rule.	(Zohar, 2000)
	Only keeps track of major safety problems and overlooks routine problems (R).	(Zohar, 2000)
	Requests employees to obey safety rules.	(Wu, 2005)
	Asks employees to enforce regulations of safety and health management thoroughly.	(Wu, 2005)
	Allows employees to involve setting safety goals.	(Wu & Lee, 2003)
Engages in safety	Involves his subordinates in decision making	(Fleming, 1999)

	Involves work group members in risk assessments	(Fleming, 1999)
	Workers are involved in setting safety goals	(Lu & Shang, 2005)
	Workers are involved in setting safety decisions	(Lu & Shang, 2005)
	Involves workers in setting safety goals	(Hayes, et al., 1998)
	Encourages employees to participate safety activities	(Wu, 2005)
	Visits the work site frequently to encourage safe working	(Fleming, 1999)
	Encourages safe behaviours	(Lu & Shang, 2005)
	Puts into practice the safety recommendations proposed by employees.	(Wu & Lee, 2003)
Acts based on suggestion	My suggestions about safety would be acted on if I expressed them to my lead supervisor.	(Taylor & Thomas III, 2003)
	Acts on safety suggestions from employees	(Lu & Shang, 2005)
	Acts on safety suggestions	(Hayes, et al., 1998)
	Emphasizes safety procedures when we are working under pressure.	(Zohar & Luria, 2005)
Does not turn a blind eye	Refuses to ignore safety rules when work falls behind schedule.	(Zohar & Luria, 2005)
	Is strict about working safely when we are tired or stressed.	(Zohar & Luria, 2005)
	Does not approve of me taking shortcuts to get a job done quickly	(Mearns, et al., 2003)
	Whenever pressure builds up, my supervisor wants us to work faster, rather than by the rules (R).	(Zohar, 2000)
	As long as work remains on schedule, my supervisor doesn't care how this has been achieved (R).	(Zohar, 2000)
	Supervisors would not compromise safety.	(Taylor & Thomas III, 2003)
	My supervisor can be trusted.	(Taylor & Thomas III, 2003)
Trust	My supervisor protects confidential sensitive information.	(Taylor & Thomas III, 2003)
	Supervisor makes realistic promises and keeps them.	(Taylor & Thomas III, 2003)
	He is trustworthy	(Mearns, et al., 2003)

Table B3. Categorised managerial behaviours identified in the subject literature

Category	Sub-category	Behaviours	Reference
Does not turn a blind eye		Is strict about working safely when work falls behind schedule.	(Zohar & Luria, 2005)
		Does not put the job before the safety of its employees	(Thompson, et al., 1998)
Communication	Provides safety information	Provides detailed safety reports to workers (e.g., injuries, near accidents).	(Zohar & Luria, 2005)
		Provides workers with a lot of information on safety issues.	(Zohar & Luria, 2005)
		Provides enough safety education programs	(Lu & Shang, 2005)
		Clearly communicates safety issues to all levels within the organization,	(Mohamed, 2003)
		Continues to bring safety information to site employees' attention,	(Mohamed, 2003)
		Undertakes campaigns to promote safe working practices.	(Mohamed, 2003)
		Is a good resource for solving safety problems,	(Mohamed, 2003)
		Provides safety information	(Hayes, et al., 1998)
		Keeps workers informed of hazards	(Hayes, et al., 1998)
	Discusses safety	Managers encourage meetings with employees and directors to discuss safety matters.	(Fernandez-Muniz, et al., 2007)
		Usually engages in regular safety talks,	(Mohamed, 2003)
		Informally discusses safety issues with employees	(Seo, et al., 2004)
	Praises for safety behaviours	Praises site employees for working safely,	(Mohamed, 2003)
	Welcomes reporting safety	Encourages feedback from site employees on safety issues,	(Mohamed, 2003)
		Welcomes reporting safety hazards/incidents,	(Mohamed, 2003)
		Values my ideas about improving safety when significant changes to working practices are suggested.	(Mohamed, 2003)
		Encourages employees to report all safety related incidents	(Seo, et al., 2004)
		Is open to new ideas on safety issues	(Thompson, et al., 1998)
	Promoting based on safety records	Considers a person's safety behaviour when moving–promoting people.	(Zohar & Luria, 2005)
	Prevents safety problems	Appears not only when there is a problem	(Mearns, Flin, et al., 2001)
		Acts only after accidents have occurred (R)	(Mohamed, 2003)
Considers safety		Shows interest in my safety	(Cox & Cheyne, 2000)

important	Clearly considers the safety of employees of great importance	(Cox & Cheyne, 2000)
	Considers safety to be equally as important as production	(Cox & Cheyne, 2000)
	Managers take responsibility for health and safety as well as quality and productivity.	(Fernandez-Muniz, et al., 2007)
	Expresses concern if safety procedures are not adhered to,	(Cox & Cheyne, 2000)
	Believes safety is very important,	(Mohamed, 2003)
	Senior management takes safety seriously.	(Fung, et al., 2005)
	Visibly demonstrates support for employees safety	(Seo, et al., 2004)
Trust	Management can be trusted.	(Taylor & Thomas III, 2003)

Appendix C

Table C1. Question set for focus groups

Introduction and warm up:

Moderator to explain:

1. The purpose of the group discussion session, and the rationale underlying the research interest in safety culture.
2. Participants to be made aware that they are under no obligation to take part in the proceedings.
3. Participants to be assured of their guaranteed anonymity and the non-attributive nature of the recording of responses.
4. Participants to be reminded of trade union's support of the discussion sessions.

Discussion format:

1. What is it like to work for this company?
2. What is it like to work in your department?
    - What is good and what is not so good?
    - What would it take to make it better?
3. Tell me about safety at this company.
    - Is it a safe place to work?
    - Is it a place where accidents happen a lot?
    - How committed are senior managers at this company to employee safety?
4. What are the main hazards where you work?
    - How do you deal with these hazards?
5. Could you tell me about initial training that new comers get when start working in your department?
    - Does the training cover Health and Safety issues?
6. Do you know about safety rules in your department?
    - How easy are they to follow?
    - How often do people bend / break the rules – examples?
    - How do supervisors react when safety rules are broken?
7. Do hazards get reported?
8. Do accidents get reported?
    - If not, why?
    - Recall a recent accident you know about. Could you tell me about that situation?
        - Why did it happen?
9. How would you describe the company's approach to accident investigations?
10. Comment on solving reported problems
    - Recall a situation when you reported a safety problem and

wanted to sort it out. Tell me about that situation.
    - (if unsolved) how did it affect you?
- What happens when you report a safety related problem?
- What does your supervisor do with the reported issue?
- Do you get feedback about reported issues?

11. What are the priorities in your department?
    - Where is safety?
12. Do you feel production pressure on you?
    - Is it difficult to meet production targets?
        - What are the consequences for not reaching targets?
        - Who puts pressure on you for unattained targets?
        - Is there any pressure from you workmates?
13. Do you have time limits for doing your tasks?
    - Do you feel time pressure?
    - Do you feel a need to bit the clock?
    - What happens if you don't bit the clock?
    - What happens if you bit the clock?
14. Do people have the resources necessary to do their job safely?
    - Recall a situation when somebody in your department did not have the resources necessary to do the job safely. Could you tell me about that situation?
    - How did it affect the way they did their job?
    - How often do you have to improvise?
15. What about respect for your work?
    - Do you feel that the company looks after you?
        - Does your supervisor look after you?
16. Is there anything else I should have asked about?

Table C2. *The full list of codes resulted from the initial coding*

1. Accident investigation (AI)	2. Lack of resources – man power	3. PPE
4. Blame,	5. Used to be better	6. Preferred shift pattern
7. Blind eye,	8. Leadership,	9. Pressure – from workmates
10. Breaking rules	11. Maintenance	12. Pressure,
13. Claims	14. Managerial skills	15. Production pressure
16. Communication	17. Managers - LMX	18. Reactive approach
19. Communication – using posters	20. Managers – no personal relation	21. Recognition – advantages
22. Consequences of lack of reaction	23. Managers – people skills	24. Recognition,
25. Contractors	26. Managers - skills managers	27. Reporting claims
28. Contradicting messages	29. Managers,	30. Reporting hazards
31. Contradictory messages	32. Minor injuries	33. Reporting,
34. Corporate	35. Money	36. Role of H&S
37. Co-workers	38. Motivation to work	39. Rules breaking
40. Cutting corners	41. Motivation to work – co-workers,	42. Safety leadership,
43. Differences in priority – managerial decisions	44. Motivation to work – co-workers,	45. Secondary risks
46. Emotions	47. Motivation to work - job itself	48. Shift leader - functions

49. External motivation	50. Motivation to work - money,	51. Shift leader - role shift leaders – limited power
52. Feedback	53. Motivation to work - pride	54. Supervision
55. Feedback – need for	56. Motivation to work – variety of tasks	57. Supervision - lack of in nightshifts
58. Feedback – newsletter	59. Need for feedback	60. Supervision – actions undertaken
61. Group consistency	62. No feedback	63. Supervision – difficult to find them
64. H&s	65. Not effective resolving	66. Supervision - fairness
67. H&s role	68. Old equipment,	69. Supervision - fairness
70. H&S team	71. Old company's culture	72. Supervision - inconsistency
73. Health effects (HE)	74. Organization of department	75. Supervision – lack of and consequences
76. Housekeeping	77. Organizational learning	78. Supervision - not enough
79. IFE	80. Paperwork	81. Supervision – not on the shop floor
82. Improvisation	83. Passivity,	84. Supervision – support for safety
85. Investigation	86. Physical conditions (pc)	87. Supervisory practices
88. Lack of equipment,	89. Pc – lack of room	90. Time pressure,
91. Lack of feedback	92. Pc - lightning	93. Training – safety on job limited
94. Lack of reaction	95. Personal time	96. Training,
97. Lack of reaction - consequences	98. Physical conditions (PC) – lack of spare space	99. Turnover,
100. Lack of reaction – postponed solution	101. Poor organization	102. Underreporting,
103. Lack of resources	104. Positive perception of company's approach to safety	105. Undertaken risks
106. Lack of resources – lifting gear	107. Postponed reaction	

Appendix D

INSTRUCTION

This is a questionnaire to assess different aspects of safety in the company. It consists of a set of demographic questions and 30 statements related to safety. Each statement is followed by a series of possible responses: strongly disagree, disagree, neutral, agree and strongly agree. Read each statement carefully and decide to what extent you agree or disagree. Indicate your answer **by circling** the corresponding answer. Please respond to every statement. Do not spend too long on each statement. It is important that you answer each question as honestly as possible. ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

1. Gender:

A) Male
B) Female

2. Age:

A) 25 years or less
B) 26 – 45 years
C) 46 years or more

3. How long have you worked for this company?:

A) less than 12 months
B) 1 – 4 years
C) 5-10 years
D) 11 years or more

TURN THE PAGE →

4. Position:

A) Operator → move to question **'5. Department'** below

B) Team leader/shift leader/cell leader → move to question **'5. Department'** below

C) Supervisor → move to question 1 on the next page

D) Manager → move to question 1 on the next page

E) Office positions → move to question 1 on the next page

(all office employees except supervisors and managers)

F) Other……………………………… → move to question **'5'** below

5. Department:

A) ABS

B) Ceramic core

C) Cleaning (pre-finishing)

D) Core Removal

E) Despatch & Packing

F) Development centre

G) E.D.M.

H) Engineering

I) Finance

J) Foundry

K) Grain Inspection

L) HEA Chem. Lab

M) HEA Maintenance

N) HEA Production

O) Heat treatment

P) Human resources

Q) H&S

R) Large Finishing

S) Large Wax

T) Layout

U) Maintenance

V) Met Lab

W) Monoshell

X) Mould prep.

Y) Production Control

Z) Quality

AA) Sales

BB) Salvage

CC) Small Finishing

DD) Small Wax

EE) Stores & Goods in

FF) Tool room

GG) IT

HH) X-Ray

HH)

Other……………………………

MOVE TO THE NEXT PAGE

.	Strongly agree	Agree	Neither agree nor disagree/ neutral	Disagree	Strongly disagree
Most of the time I have all the necessary resources to do my job safely	1	2	3	4	5
The management of my department are genuinely concerned about health and safety of employees	1	2	3	4	5
People are worried that if they say too much about safety problems, they will be seen as trouble-makers	1	2	3	4	5
Managers in my department place a high priority on fixing safety problems identified by operators	1	2	3	4	5
There are some safety problems in my department which have not been solved for a number of years	1	2	3	4	5
My supervisor regularly reminds operators to work safely	1	2	3	4	5
In my department when you ask for safety things to be fixed they usually get sorted quickly	1	2	3	4	5
People in my department get regular praise for working safely	1	2	3	4	5
The supervisors of my department sometimes allows “favourite” employees to break safety rules	1	2	3	4	5
In my department safety is sometimes sacrificed for the sake of production	1	2	3	4	5
The supervisors in my department sometimes encourage operators to take risks	1	2	3	4	5
Sometimes I feel under pressure from my workmates to work in an unsafe manner	1	2	3	4	5
People in my department often take risks by cutting corners with safety	1	2	3	4	5
The managers of my department see safety as the number one priority when setting production speeds and schedules	1	2	3	4	5
Newcomers in my department receive good quality training on the risks associated with their job	1	2	3	4	5

TURN THE PAGE →

	Strongly agree	Agree	Neither agree nor disagree/ neutral	Disagree	Strongly disagree
Accident investigations in my department are generally effective in identifying the root causes of incidents	1	2	3	4	5
In my department, what operators have to say about safety problems is not taken into consideration	1	2	3	4	5
People I work with are reluctant to use the IFE books to report incidents	1	2	3	4	5
The supervisors of my department tends to blame people who have an accident	1	2	3	4	5
In my department supervisors often turn a blind eye to unsafe practices	1	2	3	4	5
When you report safety problems the management of the department are quick to give feedback on what actions have been taken	1	2	3	4	5
In my department safety problems are only addressed when there is going to be a safety audit	1	2	3	4	5
In my department people regularly take risks to achieve output targets	1	2	3	4	5
I see IFE books as a useful tool to improve / maintain safety in my department	1	2	3	4	5
The supervisors in my department lead by example in complying with safety rules	1	2	3	4	5
There are good communications in my department about safety issues	1	2	3	4	5
The supervisors in my department frequently check to see if all employees are obeying the safety rules	1	2	3	4	5
The supervisors of my department discuss how to improve safety with operators	1	2	3	4	5
Where I work people are reluctant to report minor injuries	1	2	3	4	5
In my department hazards only tend to be removed after somebody has had an accident	1	2	3	4	5

THANK YOU!

Table D1. Results of one-way ANOVA comparison for between job grades for 2008 data

2008							
		Sum of Squares	df	Mean Square	F	Sig.	Effect size[24]
factor 1 leadership	Between Groups	810.447	5	162.089	6.591	.000	0.24
	Within Groups	10550.302	429	24.593			
	Total	11360.749	434				
factor 2 solving problems	Between Groups	984.192	5	196.838	10.336	.000	0.31
	Within Groups	7941.359	417	19.044			
	Total	8925.551	422				
factor 3 Risk taking	Between Groups	1247.512	5	249.502	7.327	.000	0.26
	Within Groups	14642.678	430	34.053			
	Total	15890.190	435				
factor 4 estrangement	Between Groups	540.934	5	108.187	8.175	.000	0.27
	Within Groups	5518.300	417	13.233			
	Total	6059.234	422				

Table D2. Results of one-way ANOVA comparison for between job grades for 2009 data

2009							
		Sum of Squares	df	Mean Square	F	Sig.	Effect size[25]
factor 1 leadership	Between Groups	910.479	5	182.096	9.129	.000	0.35
	Within Groups	5405.752	271	19.947			
	Total	6316.231	276				
factor 2 solving problems	Between Groups	677.919	5	135.584	9.763	.000	0.37
	Within Groups	3680.073	265	13.887			
	Total	4357.993	270				
factor 3 Risk taking	Between Groups	2044.195	5	408.839	16.043	.000	0.46
	Within Groups	6880.859	270	25.485			

[24] Calculated with an equation of omega squared (ω^2) (Field, 2005): $\omega 2 = \frac{SS_M - (df_M)MS_R}{SS_T + MS_R}$

[25] Calculated with an equation of omega squared (ω^2) (Field, 2005): $\omega 2 = \frac{SS_M - (df_M)MS_R}{SS_T + MS_R}$

	Total	8925.054	275				
factor 4 estrangement	Between Groups	784.972	5	156.994	11.995	.000	0.40
	Within Groups	3533.767	270	13.088			
	Total	4318.739	275				

Table D3. The results of Hochberg test for comparison between job grades for 2008 data

2008							
Dependent Variable	(I) Position	(J) Position	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
factor 1 leadership	operator	team/shift/cell leader	-.20934	.89912	1.000	-2.8558	2.4371
		supervisor	-4.62764*	1.20472	.002	-8.1736	-1.0816
		manager	-4.57209*	1.12079	.001	-7.8710	-1.2731
		office positions	-1.97685	.81893	.216	-4.3873	.4336
		other	-.72263	.93724	1.000	-3.4813	2.0360
	team/shift/cell leader	operator	.20934	.89912	1.000	-2.4371	2.8558
		supervisor	-4.41830*	1.44554	.035	-8.6731	-.1635
		manager	-4.36275*	1.37637	.024	-8.4140	-.3115
		office positions	-1.76751	1.14405	.857	-5.1349	1.5999
		other	-.51328	1.23152	1.000	-4.1381	3.1116
	supervisor	operator	4.62764*	1.20472	.002	1.0816	8.1736
		team/shift/cell leader	4.41830*	1.44554	.035	.1635	8.6731
		manager	.05556	1.59291	1.000	-4.6330	4.7441
		office positions	2.65079	1.39707	.591	-1.4614	6.7629
		other	3.90502	1.46955	.115	-.4205	8.2305
	manager	operator	4.57209*	1.12079	.001	1.2731	7.8710
		team/shift/cell leader	4.36275*	1.37637	.024	.3115	8.4140
		supervisor	-.05556	1.59291	1.000	-4.7441	4.6330
		office positions	2.59524	1.32538	.540	-1.3059	6.4964
		other	3.84946	1.40157	.090	-.2759	7.9749
	office positions	operator	1.97685	.81893	.216	-.4336	4.3873
		team/shift/cell leader	1.76751	1.14405	.857	-1.5999	5.1349
		supervisor	-2.65079	1.39707	.591	-6.7629	1.4614
		manager	-2.59524	1.32538	.540	-6.4964	1.3059
		other	1.25422	1.17425	.993	-2.2021	4.7105
	other	operator	.72263	.93724	1.000	-2.0360	3.4813
		team/shift/cell	.51328	1.23152	1.000	-3.1116	4.1381

		leader					
		supervisor	-3.90502	1.46955	.115	-8.2305	.4205
		manager	-3.84946	1.40157	.090	-7.9749	.2759
		office positions	-1.25422	1.17425	.993	-4.7105	2.2021
factor 2 solving problems	operator	team/shift/cell leader	.74379	.79301	.998	-1.5907	3.0783
		supervisor	-2.35098	1.06149	.338	-5.4758	.7739
		manager	-4.08114*	.98773	.001	-6.9889	-1.1734
		office positions	-3.93828*	.72262	.000	-6.0656	-1.8110
		other	-1.97822	.82648	.227	-4.4113	.4548
	team/shift/cell leader	operator	-.74379	.79301	.998	-3.0783	1.5907
		supervisor	-3.09477	1.27205	.207	-6.8395	.6500
		manager	-4.82493*	1.21119	.001	-8.3905	-1.2594
		office positions	-4.68207*	1.00675	.000	-7.6458	-1.7183
		other	-2.72201	1.08372	.170	-5.9123	.4683
	supervisor	operator	2.35098	1.06149	.338	-.7739	5.4758
		team/shift/cell leader	3.09477	1.27205	.207	-.6500	6.8395
		manager	-1.73016	1.40173	.974	-5.8567	2.3963
		office positions	-1.58730	1.22940	.962	-5.2065	2.0319
		other	.37276	1.29318	1.000	-3.4342	4.1797
	manager	operator	4.08114*	.98773	.001	1.1734	6.9889
		team/shift/cell leader	4.82493*	1.21119	.001	1.2594	8.3905
		supervisor	1.73016	1.40173	.974	-2.3963	5.8567
		office positions	.14286	1.16631	1.000	-3.2906	3.5763
		other	2.10292	1.23336	.749	-1.5279	5.7338
	office positions	operator	3.93828*	.72262	.000	1.8110	6.0656
		team/shift/cell leader	4.68207*	1.00675	.000	1.7183	7.6458
		supervisor	1.58730	1.22940	.962	-2.0319	5.2065
		manager	-.14286	1.16631	1.000	-3.5763	3.2906
		other	1.96006	1.03332	.592	-1.0819	5.0020
	other	operator	1.97822	.82648	.227	-.4548	4.4113
		team/shift/cell leader	2.72201	1.08372	.170	-.4683	5.9123
		supervisor	-.37276	1.29318	1.000	-4.1797	3.4342
		manager	-2.10292	1.23336	.749	-5.7338	1.5279
		office positions	-1.96006	1.03332	.592	-5.0020	1.0819
factor 3 Risk taking	operator	team/shift/cell leader	.24219	1.05782	1.000	-2.8714	3.3557
		supervisor	-3.54866	1.41748	.173	-7.7208	.6235
		manager	-4.73120*	1.31870	.006	-8.6126	-.8498
		office positions	-4.35025*	.96343	.000	-7.1860	-1.5145
		other	-1.94472	1.10268	.703	-5.1903	1.3009

	team/shift/cell leader	operator	-.24219	1.05782	1.000	-3.3557	2.8714
		supervisor	-3.79085	1.70099	.328	-8.7975	1.2158
		manager	-4.97339*	1.61960	.033	-9.7405	-.2063
		office positions	-4.59244*	1.34623	.011	-8.5549	-.6300
		other	-2.18691	1.44915	.878	-6.4523	2.0785
	supervisor	operator	3.54866	1.41748	.173	-.6235	7.7208
		team/shift/cell leader	3.79085	1.70099	.328	-1.2158	8.7975
		manager	-1.18254	1.87440	1.000	-6.6996	4.3345
		office positions	-.80159	1.64396	1.000	-5.6404	4.0372
		other	1.60394	1.72925	.998	-3.4859	6.6938
	manager	operator	4.73120*	1.31870	.006	.8498	8.6126
		team/shift/cell leader	4.97339*	1.61960	.033	.2063	9.7405
		supervisor	1.18254	1.87440	1.000	-4.3345	6.6996
		office positions	.38095	1.55960	1.000	-4.2095	4.9714
		other	2.78648	1.64925	.761	-2.0679	7.6408
	office positions	operator	4.35025*	.96343	.000	1.5145	7.1860
		team/shift/cell leader	4.59244*	1.34623	.011	.6300	8.5549
		supervisor	.80159	1.64396	1.000	-4.0372	5.6404
		manager	-.38095	1.55960	1.000	-4.9714	4.2095
		other	2.40553	1.38176	.721	-1.6615	6.4726
	other	operator	1.94472	1.10268	.703	-1.3009	5.1903
		team/shift/cell leader	2.18691	1.44915	.878	-2.0785	6.4523
		supervisor	-1.60394	1.72925	.998	-6.6938	3.4859
		manager	-2.78648	1.64925	.761	-7.6408	2.0679
		office positions	-2.40553	1.38176	.721	-6.4726	1.6615
factor 4 estrangement	operator	team/shift/cell leader	.77893	.66105	.983	-1.1671	2.7250
		supervisor	-2.18512	.88485	.189	-4.7900	.4198
		manager	-3.14544*	.82337	.002	-5.5693	-.7216
		office positions	-2.74067*	.60237	.000	-4.5140	-.9674
		other	-.99336	.68895	.910	-3.0215	1.0348
	team/shift/cell leader	operator	-.77893	.66105	.983	-2.7250	1.1671
		supervisor	-2.96405	1.06038	.078	-6.0857	.1575
		manager	-3.92437*	1.00964	.002	-6.8966	-.9521
		office positions	-3.51961*	.83922	.001	-5.9902	-1.0491
		other	-1.77230	.90338	.537	-4.4317	.8871
	supervisor	operator	2.18512	.88485	.189	-.4198	4.7900
		team/shift/cell leader	2.96405	1.06038	.078	-.1575	6.0857
		manager	-.96032	1.16848	1.000	-4.4002	2.4795
		office positions	-.55556	1.02482	1.000	-3.5725	2.4614

		other	1.19176	1.07799	.991	-1.9817	4.3652
	manager	operator	3.14544*	.82337	.002	.7216	5.5693
		team/shift/cell leader	3.92437*	1.00964	.002	.9521	6.8966
		supervisor	.96032	1.16848	1.000	-2.4795	4.4002
		office positions	.40476	.97223	1.000	-2.4574	3.2669
		other	2.15207	1.02812	.429	-.8746	5.1787
	office positions	operator	2.74067*	.60237	.000	.9674	4.5140
		team/shift/cell leader	3.51961*	.83922	.001	1.0491	5.9902
		supervisor	.55556	1.02482	1.000	-2.4614	3.5725
		manager	-.40476	.97223	1.000	-3.2669	2.4574
		other	1.74731	.86137	.481	-.7884	4.2831
	other	operator	.99336	.68895	.910	-1.0348	3.0215
		team/shift/cell leader	1.77230	.90338	.537	-.8871	4.4317
		supervisor	-1.19176	1.07799	.991	-4.3652	1.9817
		manager	-2.15207	1.02812	.429	-5.1787	.8746
		office positions	-1.74731	.86137	.481	-4.2831	.7884

Table D4. The results of Gabriel test for comparison between job grades for 2009 data

2009							
Dependent Variable	(I) Position	(J) Position	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
factor 1 leadership	operator	team/shift/cell leader	-1.03894	.90749	.975	-3.5395	1.4616
		supervisor	-5.94610*	1.29233	.000	-9.3013	-2.5909
		manager	-3.91600*	1.00149	.000	-6.6294	-1.2026
		office positions	-3.47687*	.79648	.000	-5.7203	-1.2335
		other	-2.53687	.96623	.069	-5.1708	.0971
	team/shift/cell leader	operator	1.03894	.90749	.975	-1.4616	3.5395
		supervisor	-4.90716*	1.49072	.013	-9.2248	-.5895
		manager	-2.87706	1.24705	.277	-6.5529	.7987
		office positions	-2.43793	1.08928	.319	-5.6438	.7679
		other	-1.49793	1.21891	.974	-5.0943	2.0985
	supervisor	operator	5.94610*	1.29233	.000	2.5909	9.3013
		team/shift/cell leader	4.90716*	1.49072	.013	.5895	9.2248
		manager	2.03010	1.54974	.953	-2.5003	6.5605
		office positions	2.46923	1.42587	.677	-1.5913	6.5297
		other	3.40923	1.52719	.308	-1.0418	7.8603

	manager	operator	3.91600*	1.00149	.000	1.2026	6.6294
		team/shift/cell leader	2.87706	1.24705	.277	-.7987	6.5529
		supervisor	-2.03010	1.54974	.953	-6.5605	2.5003
		office positions	.43913	1.16875	1.000	-2.9795	3.8578
		other	1.37913	1.29042	.993	-2.4301	5.1883
	office positions	operator	3.47687*	.79648	.000	1.2335	5.7203
		team/shift/cell leader	2.43793	1.08928	.319	-.7679	5.6438
		supervisor	-2.46923	1.42587	.677	-6.5297	1.5913
		manager	-.43913	1.16875	1.000	-3.8578	2.9795
		other	.94000	1.13868	1.000	-2.3992	4.2792
	other	operator	2.53687	.96623	.069	-.0971	5.1708
		team/shift/cell leader	1.49793	1.21891	.974	-2.0985	5.0943
		supervisor	-3.40923	1.52719	.308	-7.8603	1.0418
		manager	-1.37913	1.29042	.993	-5.1883	2.4301
		office positions	-.94000	1.13868	1.000	-4.2792	2.3992
factor 2 solving problems	operator	team/shift/cell leader	.67757	.77056	.998	-1.4460	2.8012
		supervisor	-3.73727*	1.07983	.002	-6.5485	-.9260
		manager	-3.73393*	.83760	.000	-6.0095	-1.4583
		office positions	-2.72958*	.66706	.000	-4.6130	-.8462
		other	-2.66958*	.80826	.006	-4.8789	-.4602
	team/shift/cell leader	operator	-.67757	.77056	.998	-2.8012	1.4460
		supervisor	-4.41484*	1.25068	.006	-8.0437	-.7860
		manager	-4.41149*	1.04869	.001	-7.5047	-1.3183
		office positions	-3.40714*	.91823	.004	-6.1081	-.7062
		other	-3.34714*	1.02540	.018	-6.3741	-.3202
	supervisor	operator	3.73727*	1.07983	.002	.9260	6.5485
		team/shift/cell leader	4.41484*	1.25068	.006	.7860	8.0437
		manager	.00334	1.29307	1.000	-3.7775	3.7842
		office positions	1.00769	1.18971	.999	-2.3809	4.3963
		other	1.06769	1.27425	.999	-2.6469	4.7823
	manager	operator	3.73393*	.83760	.000	1.4583	6.0095
		team/shift/cell leader	4.41149*	1.04869	.001	1.3183	7.5047
		supervisor	-.00334	1.29307	1.000	-3.7842	3.7775
		office positions	1.00435	.97517	.995	-1.8486	3.8573
		other	1.06435	1.07669	.997	-2.1146	4.2433
	office positions	operator	2.72958*	.66706	.000	.8462	4.6130
		team/shift/cell leader	3.40714*	.91823	.004	.7062	6.1081
		supervisor	-1.00769	1.18971	.999	-4.3963	2.3809
		manager	-1.00435	.97517	.995	-3.8573	1.8486

		other	.06000	.95008	1.000	-2.7267	2.8467
	other	operator	2.66958*	.80826	.006	.4602	4.8789
		team/shift/cell leader	3.34714*	1.02540	.018	.3202	6.3741
		supervisor	-1.06769	1.27425	.999	-4.7823	2.6469
		manager	-1.06435	1.07669	.997	-4.2433	2.1146
		office positions	-.06000	.95008	1.000	-2.8467	2.7267
factor 3 Risk taking	operator	team/shift/cell leader	.18706	1.02632	1.000	-2.6424	3.0165
		supervisor	-7.04636*	1.46113	.000	-10.8419	-3.2508
		manager	-6.25372*	1.13251	.000	-9.3237	-3.1837
		office positions	-5.07329*	.90093	.000	-7.6121	-2.5345
		other	-4.80329*	1.09268	.000	-7.7835	-1.8230
	team/shift/cell leader	operator	-.18706	1.02632	1.000	-3.0165	2.6424
		supervisor	-7.23342*	1.68497	.000	-12.1139	-2.3530
		manager	-6.44078*	1.40954	.000	-10.5957	-2.2859
		office positions	-5.26034*	1.23122	.000	-8.8840	-1.6366
		other	-4.99034*	1.37774	.005	-9.0555	-.9252
	supervisor	operator	7.04636*	1.46113	.000	3.2508	10.8419
		team/shift/cell leader	7.23342*	1.68497	.000	2.3530	12.1139
		manager	.79264	1.75168	1.000	-4.3283	5.9136
		office positions	1.97308	1.61167	.966	-2.6167	6.5628
		other	2.24308	1.72619	.954	-2.7881	7.2743
	manager	operator	6.25372*	1.13251	.000	3.1837	9.3237
		team/shift/cell leader	6.44078*	1.40954	.000	2.2859	10.5957
		supervisor	-.79264	1.75168	1.000	-5.9136	4.3283
		office positions	1.18043	1.32104	.999	-2.6838	5.0446
		other	1.45043	1.45857	.997	-2.8553	5.7561
	office positions	operator	5.07329*	.90093	.000	2.5345	7.6121
		team/shift/cell leader	5.26034*	1.23122	.000	1.6366	8.8840
		supervisor	-1.97308	1.61167	.966	-6.5628	2.6167
		manager	-1.18043	1.32104	.999	-5.0446	2.6838
		other	.27000	1.28705	1.000	-3.5045	4.0445
	other	operator	4.80329*	1.09268	.000	1.8230	7.7835
		team/shift/cell leader	4.99034*	1.37774	.005	.9252	9.0555
		supervisor	-2.24308	1.72619	.954	-7.2743	2.7881
		manager	-1.45043	1.45857	.997	-5.7561	2.8553
		office positions	-.27000	1.28705	1.000	-4.0445	3.5045
factor 4 estrangement	operator	team/shift/cell leader	-.03912	.74596	1.000	-2.0895	2.0113
		supervisor	-3.97593*	1.04681	.000	-6.6938	-1.2581
		manager	-4.40402*	.81122	.000	-6.6020	-2.2061

		office positions	-3.08554*	.64516	.000	-4.9028	-1.2683
		other	-2.72054*	.78266	.003	-4.8542	-.5869
	team/shift/cell leader	operator	.03912	.74596	1.000	-2.0113	2.0895
		supervisor	-3.93681*	1.21417	.016	-7.4591	-.4145
		manager	-4.36491*	1.01807	.000	-7.3673	-1.3625
		office positions	-3.04643*	.89142	.010	-5.6681	-.4247
		other	-2.68143	.99546	.106	-5.6195	.2566
	supervisor	operator	3.97593*	1.04681	.000	1.2581	6.6938
		team/shift/cell leader	3.93681*	1.21417	.016	.4145	7.4591
		manager	-.42809	1.25531	1.000	-4.0979	3.2418
		office positions	.89038	1.15498	1.000	-2.3988	4.1795
		other	1.25538	1.23705	.995	-2.3502	4.8609
	manager	operator	4.40402*	.81122	.000	2.2061	6.6020
		team/shift/cell leader	4.36491*	1.01807	.000	1.3625	7.3673
		supervisor	.42809	1.25531	1.000	-3.2418	4.0979
		office positions	1.31848	.94670	.925	-1.4508	4.0877
		other	1.68348	1.04526	.816	-1.4021	4.7691
	office positions	operator	3.08554*	.64516	.000	1.2683	4.9028
		team/shift/cell leader	3.04643*	.89142	.010	.4247	5.6681
		supervisor	-.89038	1.15498	1.000	-4.1795	2.3988
		manager	-1.31848	.94670	.925	-4.0877	1.4508
		other	.36500	.92235	1.000	-2.3399	3.0699
	other	operator	2.72054*	.78266	.003	.5869	4.8542
		team/shift/cell leader	2.68143	.99546	.106	-.2566	5.6195
		supervisor	-1.25538	1.23705	.995	-4.8609	2.3502
		manager	-1.68348	1.04526	.816	-4.7691	1.4021
		office positions	-.36500	.92235	1.000	-3.0699	2.3399

Table D5. Results of Levene statistic of inter-departmental differences for data sets from 2008 and 2009

	2008				2009			
	Levene Statistic	df1	df2	Sig.	Levene Statistic	df1	df2	Sig.
factor 1 leadership	2.129	8	277	.033	2.329	4	131	.059
factor 2 solving problems	2.155	8	269	.031	1.080	4	129	.369
factor 3 breaking rules	1.270	8	278	.259	.765	4	130	.550
factor 4 estrangement	1.637	8	269	.114	1.266	4	130	.287

Table D6. Results of one-way ANOVA of inter-departmental differences for 2008 data set

ANOVA		2008					
		Sum of Squares	df	Mean Square	F	Sig.	Effect size[26]
factor 1 leadership	Between Groups	459.269	8	57.409	2.319	.020	0.18
	Within Groups	6858.227	277	24.759			
	Total	7317.497	285				
factor 2 solving problems	Between Groups	1044.866	8	130.608	7.807	.000	0.40
	Within Groups	4500.011	269	16.729			
	Total	5544.878	277				
factor 3 risk taking	Between Groups	905.203	8	113.150	3.627	.000	0.26
	Within Groups	8672.051	278	31.194			
	Total	9577.254	286				
factor 4 estrangement	Between Groups	379.976	8	47.497	3.552	.001	0.26
	Within Groups	3597.347	269	13.373			
	Total	3977.324	277				

Table D7. Results of one-way ANOVA of inter-departmental differences for 2009 data set

ANOVA		2009					
		Sum of Squares	df	Mean Square	F	Sig.	Effect size[27]
factor 1 leadership	Between Groups	37.926	4	9.482	.545	.703	ω^2 negative. No square root possible
	Within Groups	2278.074	131	17.390			
	Total	2316.000	135				
factor 2 solving problems	Between Groups	186.037	4	46.509	4.980	.001	0.32
	Within Groups	1204.747	129	9.339			
	Total	1390.784	133				
factor 3 breaking rules	Between Groups	223.899	4	55.975	2.834	.027	0.22
	Within Groups	2567.804	130	19.752			
	Total	2791.704	134				

[26] Calculated with an equation of omega squared (ω^2) (Field, 2005): $\omega 2 = \frac{SS_M - (df_M)MS_R}{SS_T + MS_R}$

[27] Calculated with an equation of omega squared (ω^2) (Field, 2005): $\omega 2 = \frac{SS_M - (df_M)MS_R}{SS_T + MS_R}$

factor 4 estrangement	Between Groups	149.241	4	37.310	3.439	.010	0.25
	Within Groups	1410.359	130	10.849			
	Total	1559.600	134				

Table D8.Results of Games-Howell test of inter-departmental differences for 2008 data set

Dependent Variable	(I) departments only with more than 20 people	(J) departments only with more than 20 people	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
factor 1 leadership	ceramic core	foundry	3.80223*	1.10401	.026	.2667	7.3377
		HEA production	-.05303	1.36337	1.000	-4.5061	4.4000
		large finishing	1.32554	1.15725	.965	-2.3868	5.0379
		large wax	1.49697	.98005	.839	-1.6455	4.6395
		monoshell	1.53907	1.26467	.948	-2.6189	5.6971
		mould prep.	5.32197*	1.32759	.023	.5515	10.0925
		small finishing	2.32855	1.67967	.894	-3.3129	7.9700
		small wax	1.91235	1.01330	.624	-1.3223	5.1470
	foundry	ceramic core	-3.80223*	1.10401	.026	-7.3377	-.2667
		HEA production	-3.85526	1.38034	.146	-8.3528	.6422
		large finishing	-2.47669	1.17719	.479	-6.2450	1.2916
		large wax	-2.30526	1.00352	.358	-5.5140	.9035
		monoshell	-2.26316	1.28294	.704	-6.4679	1.9415
		mould prep.	1.51974	1.34501	.960	-3.2777	6.3172
		small finishing	-1.47368	1.69347	.993	-7.1471	4.1997
		small wax	-1.88988	1.03601	.666	-5.1895	1.4098
	HEA production	ceramic core	.05303	1.36337	1.000	-4.4000	4.5061
		foundry	3.85526	1.38034	.146	-.6422	8.3528
		large finishing	1.37857	1.42328	.987	-3.2471	6.0043
		large wax	1.55000	1.28335	.950	-2.6754	5.7754
		monoshell	1.59211	1.51191	.978	-3.3559	6.5401
		mould prep.	5.37500*	1.56492	.049	.0204	10.7296
		small finishing	2.38158	1.87291	.933	-3.8004	8.5635
		small wax	1.96538	1.30892	.848	-2.3242	6.2550
	large finishing	ceramic core	-1.32554	1.15725	.965	-5.0379	2.3868

		foundry	2.47669	1.17719	.479	-1.2916	6.2450
		HEA production	-1.37857	1.42328	.987	-6.0043	3.2471
		large wax	.17143	1.06180	1.000	-3.2373	3.5801
		monoshell	.21353	1.32903	1.000	-4.1287	4.5557
		mould prep.	3.99643	1.38904	.162	-.8922	8.8850
		small finishing	1.00301	1.72865	1.000	-4.7615	6.7675
		small wax	.58681	1.09257	1.000	-2.9069	4.0805
	large wax	ceramic core	-1.49697	.98005	.839	-4.6395	1.6455
		foundry	2.30526	1.00352	.358	-.9035	5.5140
		HEA production	-1.55000	1.28335	.950	-5.7754	2.6754
		large finishing	-.17143	1.06180	1.000	-3.5801	3.2373
		monoshell	.04211	1.17796	1.000	-3.8716	3.9559
		mould prep.	3.82500	1.24526	.140	-.8133	8.4633
		small finishing	.83158	1.61539	1.000	-4.6538	6.3170
		small wax	.41538	.90275	1.000	-2.4431	3.2738
	monoshell	ceramic core	-1.53907	1.26467	.948	-5.6971	2.6189
		foundry	2.26316	1.28294	.704	-1.9415	6.4679
		HEA production	-1.59211	1.51191	.978	-6.5401	3.3559
		large finishing	-.21353	1.32903	1.000	-4.5557	4.1287
		large wax	-.04211	1.17796	1.000	-3.9559	3.8716
		mould prep.	3.78289	1.47972	.267	-1.3744	8.9402
		small finishing	.78947	1.80233	1.000	-5.2044	6.7834
		small wax	.37328	1.20576	1.000	-3.6078	4.3544
	mould prep.	ceramic core	-5.32197*	1.32759	.023	-10.0925	-.5515
		foundry	-1.51974	1.34501	.960	-6.3172	3.2777
		HEA production	-5.37500*	1.56492	.049	-10.7296	-.0204
		large finishing	-3.99643	1.38904	.162	-8.8850	.8922
		large wax	-3.82500	1.24526	.140	-8.4633	.8133
		monoshell	-3.78289	1.47972	.267	-8.9402	1.3744
		small finishing	-2.99342	1.84702	.785	-9.2600	3.2731
		small wax	-3.40962	1.27160	.242	-8.0765	1.2573
	small finishing	ceramic core	-2.32855	1.67967	.894	-7.9700	3.3129
		foundry	1.47368	1.69347	.993	-4.1997	7.1471
		HEA production	-2.38158	1.87291	.933	-8.5635	3.8004

		large finishing	-1.00301	1.72865	1.000	-6.7675	4.7615
		large wax	-.83158	1.61539	1.000	-6.3170	4.6538
		monoshell	-.78947	1.80233	1.000	-6.7834	5.2044
		mould prep.	2.99342	1.84702	.785	-3.2731	9.2600
		small wax	-.41619	1.63578	1.000	-5.9461	5.1137
	small wax	ceramic core	-1.91235	1.01330	.624	-5.1470	1.3223
		foundry	1.88988	1.03601	.666	-1.4098	5.1895
		HEA production	-1.96538	1.30892	.848	-6.2550	2.3242
		large finishing	-.58681	1.09257	1.000	-4.0805	2.9069
		large wax	-.41538	.90275	1.000	-3.2738	2.4431
		monoshell	-.37328	1.20576	1.000	-4.3544	3.6078
		mould prep.	3.40962	1.27160	.242	-1.2573	8.0765
		small finishing	.41619	1.63578	1.000	-5.1137	5.9461
factor 2 solving problems	ceramic core	foundry	5.48736*	.87091	.000	2.6831	8.2916
		HEA production	-.16129	1.00575	1.000	-3.4921	3.1695
		large finishing	4.75300*	.83028	.000	2.0782	7.4278
		large wax	3.58871*	.66530	.000	1.4606	5.7168
		monoshell	4.00538*	1.05054	.019	.4512	7.5596
		mould prep.	7.58871*	1.14513	.001	3.1568	12.0207
		small finishing	3.73345	1.37083	.194	-.9508	8.4177
		small wax	2.75934*	.73306	.009	.4292	5.0895
	foundry	ceramic core	-5.48736*	.87091	.000	-8.2916	-2.6831
		HEA production	-5.64865*	1.15922	.000	-9.4111	-1.8862
		large finishing	-.73436	1.01075	.998	-3.9698	2.5010
		large wax	-1.89865	.88028	.446	-4.7257	.9284
		monoshell	-1.48198	1.19829	.943	-5.4229	2.4590
		mould prep.	2.10135	1.28202	.771	-2.5029	6.7056
		small finishing	-1.75391	1.48708	.955	-6.7158	3.2080
		small wax	-2.72801	.93255	.099	-5.7056	.2496
	HEA production	ceramic core	.16129	1.00575	1.000	-3.1695	3.4921
		foundry	5.64865*	1.15922	.000	1.8862	9.4111
		large finishing	4.91429*	1.12901	.002	1.2392	8.5894
		large wax	3.75000*	1.01387	.019	.4013	7.0987
		monoshell	4.16667	1.29959	.061	-.1063	8.4397

		mould prep.	7.75000*	1.37718	.001	2.9204	12.5796
		small finishing	3.89474	1.56986	.277	-1.3084	9.0978
		small wax	2.92063	1.05957	.160	-.5466	6.3878
	large finishing	ceramic core	-4.75300*	.83028	.000	-7.4278	-2.0782
		foundry	.73436	1.01075	.998	-2.5010	3.9698
		HEA production	-4.91429*	1.12901	.002	-8.5894	-1.2392
		large wax	-1.16429	.84010	.899	-3.8626	1.5340
		monoshell	-.74762	1.16909	.999	-4.6087	3.1135
		mould prep.	2.83571	1.25478	.423	-1.7237	7.3951
		small finishing	-1.01955	1.46366	.998	-5.9230	3.8839
		small wax	-1.99365	.89472	.399	-4.8498	.8625
	large wax	ceramic core	-3.58871*	.66530	.000	-5.7168	-1.4606
		foundry	1.89865	.88028	.446	-.9284	4.7257
		HEA production	-3.75000*	1.01387	.019	-7.0987	-.4013
		large finishing	1.16429	.84010	.899	-1.5340	3.8626
		monoshell	.41667	1.05832	1.000	-3.1530	3.9864
		mould prep.	4.00000	1.15227	.087	-.4339	8.4339
		small finishing	.14474	1.37680	1.000	-4.5513	4.8408
		small wax	-.82937	.74417	.971	-3.1865	1.5278
	monoshell	ceramic core	-4.00538*	1.05054	.019	-7.5596	-.4512
		foundry	1.48198	1.19829	.943	-2.4590	5.4229
		HEA production	-4.16667	1.29959	.061	-8.4397	.1063
		large finishing	.74762	1.16909	.999	-3.1135	4.6087
		large wax	-.41667	1.05832	1.000	-3.9864	3.1530
		mould prep.	3.58333	1.41023	.276	-1.3558	8.5224
		small finishing	-.27193	1.59893	1.000	-5.5780	5.0341
		small wax	-1.24603	1.10218	.965	-4.9199	2.4279
	mould prep.	ceramic core	-7.58871*	1.14513	.001	-12.0207	-3.1568
		foundry	-2.10135	1.28202	.771	-6.7056	2.5029
		HEA production	-7.75000*	1.37718	.001	-12.5796	-2.9204
		large finishing	-2.83571	1.25478	.423	-7.3951	1.7237
		large wax	-4.00000	1.15227	.087	-8.4339	.4339
		monoshell	-3.58333	1.41023	.276	-8.5224	1.3558
		small	-3.85526	1.66261	.371	-9.5196	1.8091

		finishing						
		small wax	-4.82937*	1.19268	.031	-9.2957	-.3631
	small finishing	ceramic core	-3.73345	1.37083	.194	-8.4177	.9508
		foundry	1.75391	1.48708	.955	-3.2080	6.7158
		HEA production	-3.89474	1.56986	.277	-9.0978	1.3084
		large finishing	1.01955	1.46366	.998	-3.8839	5.9230
		large wax	-.14474	1.37680	1.000	-4.8408	4.5513
		monoshell	.27193	1.59893	1.000	-5.0341	5.5780
		mould prep.	3.85526	1.66261	.371	-1.8091	9.5196
		small wax	-.97410	1.41079	.998	-5.7451	3.7969
	small wax	ceramic core	-2.75934*	.73306	.009	-5.0895	-.4292
		foundry	2.72801	.93255	.099	-.2496	5.7056
		HEA production	-2.92063	1.05957	.160	-6.3878	.5466
		large finishing	1.99365	.89472	.399	-.8625	4.8498
		large wax	.82937	.74417	.971	-1.5278	3.1865
		monoshell	1.24603	1.10218	.965	-2.4279	4.9199
		mould prep.	4.82937*	1.19268	.031	.3631	9.2957
		small finishing	.97410	1.41079	.998	-3.7969	5.7451
factor 3 breaking rules	ceramic core	foundry	5.13313*	1.21745	.002	1.2360	9.0302
		HEA production	.84804	1.60115	1.000	-4.4091	6.1052
		large finishing	1.06471	1.12850	.989	-2.5529	4.6823
		large wax	2.13137	1.07702	.563	-1.3146	5.5774
		monoshell	-.78793	1.43731	1.000	-5.5362	3.9603
		mould prep.	5.63971	1.96004	.202	-1.9046	13.1840
		small finishing	1.36997	1.69223	.996	-4.2907	7.0307
		small wax	.57240	1.13786	1.000	-3.0490	4.1938
	foundry	ceramic core	-5.13313*	1.21745	.002	-9.0302	-1.2360
		HEA production	-4.28509	1.64772	.217	-9.6694	1.0992
		large finishing	-4.06842*	1.19365	.028	-7.8887	-.2481
		large wax	-3.00175	1.14512	.196	-6.6625	.6590
		monoshell	-5.92105*	1.48902	.008	-10.8096	-1.0325
		mould prep.	.50658	1.99827	1.000	-7.0675	8.0807
		small finishing	-3.76316	1.73636	.449	-9.5352	2.0089
		small wax	-4.56073*	1.20251	.008	-8.3869	-.7345

	HEA production	ceramic core	-.84804	1.60115	1.000	-6.1052	4.4091
		foundry	4.28509	1.64772	.217	-1.0992	9.6694
		large finishing	.21667	1.58313	1.000	-4.9904	5.4238
		large wax	1.28333	1.54687	.995	-3.8231	6.3897
		monoshell	-1.63596	1.81623	.992	-7.5802	4.3082
		mould prep.	4.79167	2.25268	.490	-3.2144	12.7977
		small finishing	.52193	2.02397	1.000	-6.1156	7.1595
		small wax	-.27564	1.58982	1.000	-5.4912	4.9399
	large finishing	ceramic core	-1.06471	1.12850	.989	-4.6823	2.5529
		foundry	4.06842*	1.19365	.028	.2481	7.8887
		HEA production	-.21667	1.58313	1.000	-5.4238	4.9904
		large wax	1.06667	1.05005	.983	-2.2887	4.4220
		monoshell	-1.85263	1.41721	.922	-6.5451	2.8398
		mould prep.	4.57500	1.94536	.396	-2.9593	12.1093
		small finishing	.30526	1.67520	1.000	-5.3119	5.9225
		small wax	-.49231	1.11237	1.000	-4.0283	3.0437
	large wax	ceramic core	-2.13137	1.07702	.563	-5.5774	1.3146
		foundry	3.00175	1.14512	.196	-.6590	6.6625
		HEA production	-1.28333	1.54687	.995	-6.3897	3.8231
		large finishing	-1.06667	1.05005	.983	-4.4220	2.2887
		monoshell	-2.91930	1.37658	.478	-7.4991	1.6605
		mould prep.	3.50833	1.91596	.666	-4.0096	11.0263
		small finishing	-.76140	1.64096	1.000	-6.2919	4.7691
		small wax	-1.55897	1.06011	.867	-4.9152	1.7973
	monoshell	ceramic core	.78793	1.43731	1.000	-3.9603	5.5362
		foundry	5.92105*	1.48902	.008	1.0325	10.8096
		HEA production	1.63596	1.81623	.992	-4.3082	7.5802
		large finishing	1.85263	1.41721	.922	-2.8398	6.5451
		large wax	2.91930	1.37658	.478	-1.6605	7.4991
		mould prep.	6.42763	2.13934	.146	-1.3768	14.2321
		small finishing	2.15789	1.89701	.964	-4.1155	8.4313
		small wax	1.36032	1.42468	.988	-3.3387	6.0594
	mould prep.	ceramic core	-5.63971	1.96004	.202	-13.1840	1.9046
		foundry	-.50658	1.99827	1.000	-8.0807	7.0675

		HEA production	-4.79167	2.25268	.490	-12.7977	3.2144
		large finishing	-4.57500	1.94536	.396	-12.1093	2.9593
		large wax	-3.50833	1.91596	.666	-11.0263	4.0096
		monoshell	-6.42763	2.13934	.146	-14.2321	1.3768
		small finishing	-4.26974	2.31831	.657	-12.4576	3.9181
		small wax	-5.06731	1.95080	.293	-12.5988	2.4641
	small finishing	ceramic core	-1.36997	1.69223	.996	-7.0307	4.2907
		foundry	3.76316	1.73636	.449	-2.0089	9.5352
		HEA production	-.52193	2.02397	1.000	-7.1595	6.1156
		large finishing	-.30526	1.67520	1.000	-5.9225	5.3119
		large wax	.76140	1.64096	1.000	-4.7691	6.2919
		monoshell	-2.15789	1.89701	.964	-8.4313	4.1155
		mould prep.	4.26974	2.31831	.657	-3.9181	12.4576
		small wax	-.79757	1.68152	1.000	-6.4222	4.8270
	small wax	ceramic core	-.57240	1.13786	1.000	-4.1938	3.0490
		foundry	4.56073*	1.20251	.008	.7345	8.3869
		HEA production	.27564	1.58982	1.000	-4.9399	5.4912
		large finishing	.49231	1.11237	1.000	-3.0437	4.0283
		large wax	1.55897	1.06011	.867	-1.7973	4.9152
		monoshell	-1.36032	1.42468	.988	-6.0594	3.3387
		mould prep.	5.06731	1.95080	.293	-2.4641	12.5988
		small finishing	.79757	1.68152	1.000	-4.8270	6.4222
factor 4 estrangement	ceramic core	foundry	3.47515*	.88626	.007	.6229	6.3274
		HEA production	-.55540	1.05991	1.000	-3.9976	2.8868
		large finishing	1.49677	.95491	.818	-1.5704	4.5640
		large wax	2.23314	.84911	.197	-.5044	4.9706
		monoshell	1.65233	.91598	.679	-1.3272	4.6318
		mould prep.	3.22177	1.36287	.376	-1.8189	8.2624
		small finishing	2.57046	1.02951	.262	-.7910	5.9319
		small wax	1.27138	.87317	.871	-1.5316	4.0744
	foundry	ceramic core	-3.47515*	.88626	.007	-6.3274	-.6229
		HEA production	-4.03055*	.96933	.004	-7.1991	-.8620
		large finishing	-1.97838	.85326	.346	-4.7130	.7563

	large wax	-1.24201	.73293	.748	-3.5825	1.0984
	monoshell	-1.82282	.80946	.392	-4.4642	.8186
	mould prep.	-.25338	1.29368	1.000	-5.2160	4.7092
	small finishing	-.90469	.93599	.987	-3.9870	2.1776
	small wax	-2.20378	.76067	.103	-4.6222	.2147
HEA production	ceramic core	.55540	1.05991	1.000	-2.8868	3.9976
	foundry	4.03055*	.96933	.004	.8620	7.1991
	large finishing	2.05217	1.03247	.559	-1.3020	5.4064
	large wax	2.78854	.93548	.101	-.2832	5.8603
	monoshell	2.20773	.99658	.417	-1.0674	5.4828
	mould prep.	3.77717	1.41829	.244	-1.3642	8.9186
	small finishing	3.12586	1.10183	.136	-.4853	6.7371
	small wax	1.82678	.95738	.612	-1.3007	4.9542
large finishing	ceramic core	-1.49677	.95491	.818	-4.5640	1.5704
	foundry	1.97838	.85326	.346	-.7563	4.7130
	HEA production	-2.05217	1.03247	.559	-5.4064	1.3020
	large wax	.73636	.81460	.992	-1.8760	3.3487
	monoshell	.15556	.88409	1.000	-2.7156	3.0267
	mould prep.	1.72500	1.34164	.918	-3.2855	6.7355
	small finishing	1.07368	1.00124	.975	-2.1976	4.3450
	small wax	-.22540	.83966	1.000	-2.9072	2.4564
large wax	ceramic core	-2.23314	.84911	.197	-4.9706	.5044
	foundry	1.24201	.73293	.748	-1.0984	3.5825
	HEA production	-2.78854	.93548	.101	-5.8603	.2832
	large finishing	-.73636	.81460	.992	-3.3487	1.8760
	monoshell	-.58081	.76860	.997	-3.0990	1.9373
	mould prep.	.98864	1.26851	.995	-3.9574	5.9347
	small finishing	.33732	.90089	1.000	-2.6467	3.3214
	small wax	-.96176	.71704	.916	-3.2335	1.3100
monoshell	ceramic core	-1.65233	.91598	.679	-4.6318	1.3272
	foundry	1.82282	.80946	.392	-.8186	4.4642
	HEA production	-2.20773	.99658	.417	-5.4828	1.0674
	large finishing	-.15556	.88409	1.000	-3.0267	2.7156

		large wax	.58081	.76860	.997	-1.9373	3.0990
		mould prep.	1.56944	1.31422	.942	-3.4249	6.5638
		small finishing	.91813	.96418	.988	-2.2751	4.1114
		small wax	-.38095	.79510	1.000	-2.9672	2.2053
	mould prep.	ceramic core	-3.22177	1.36287	.376	-8.2624	1.8189
		foundry	.25338	1.29368	1.000	-4.7092	5.2160
		HEA production	-3.77717	1.41829	.244	-8.9186	1.3642
		large finishing	-1.72500	1.34164	.918	-6.7355	3.2855
		large wax	-.98864	1.26851	.995	-5.9347	3.9574
		monoshell	-1.56944	1.31422	.942	-6.5638	3.4249
		small finishing	-.65132	1.39572	1.000	-5.7628	4.4601
		small wax	-1.95040	1.28474	.825	-6.9031	3.0023
	small finishing	ceramic core	-2.57046	1.02951	.262	-5.9319	.7910
		foundry	.90469	.93599	.987	-2.1776	3.9870
		HEA production	-3.12586	1.10183	.136	-6.7371	.4853
		large finishing	-1.07368	1.00124	.975	-4.3450	2.1976
		large wax	-.33732	.90089	1.000	-3.3214	2.6467
		monoshell	-.91813	.96418	.988	-4.1114	2.2751
		mould prep.	.65132	1.39572	1.000	-4.4601	5.7628
		small wax	-1.29908	.92361	.888	-4.3389	1.7408
	small wax	ceramic core	-1.27138	.87317	.871	-4.0744	1.5316
		foundry	2.20378	.76067	.103	-.2147	4.6222
		HEA production	-1.82678	.95738	.612	-4.9542	1.3007
		large finishing	.22540	.83966	1.000	-2.4564	2.9072
		large wax	.96176	.71704	.916	-1.3100	3.2335
		monoshell	.38095	.79510	1.000	-2.2053	2.9672
		mould prep.	1.95040	1.28474	.825	-3.0023	6.9031
		small finishing	1.29908	.92361	.888	-1.7408	4.3389

Table D9. Results of Gabriel test of inter-departmental differences for 2009 data set

Dependent Variable	Departments	Departments	Mean Differenc	Std. Error	Sig.	95% Confidence Interval

			e (I-J)			Lower Bound	Upper Bound
factor 1 leadership	ceramic core	cleaning	1.67636	1.21903	.840	-1.7902	5.1429
		foundry	1.40559	1.20801	.937	-2.0284	4.8396
		large wax	1.19192	1.12850	.964	-1.9950	4.3788
		small wax	1.22896	1.19771	.972	-2.1743	4.6322
	cleaning	ceramic core	-1.67636	1.21903	.840	-5.1429	1.7902
		foundry	-.27077	1.16809	1.000	-3.5940	3.0525
		large wax	-.48444	1.08566	1.000	-3.5606	2.5917
		small wax	-.44741	1.15744	1.000	-3.7399	2.8451
	foundry	ceramic core	-1.40559	1.20801	.937	-4.8396	2.0284
		cleaning	.27077	1.16809	1.000	-3.0525	3.5940
		large wax	-.21368	1.07326	1.000	-3.2573	2.8299
		small wax	-.17664	1.14582	1.000	-3.4365	3.0833
	large wax	ceramic core	-1.19192	1.12850	.964	-4.3788	1.9950
		cleaning	.48444	1.08566	1.000	-2.5917	3.5606
		foundry	.21368	1.07326	1.000	-2.8299	3.2573
		small wax	.03704	1.06166	1.000	-2.9758	3.0499
	small wax	ceramic core	-1.22896	1.19771	.972	-4.6322	2.1743
		cleaning	.44741	1.15744	1.000	-2.8451	3.7399
		foundry	.17664	1.14582	1.000	-3.0833	3.4365
		large wax	-.03704	1.06166	1.000	-3.0499	2.9758
factor 2 solving problems	ceramic core	cleaning	3.60474*	.91135	.001	1.0113	6.1982
		foundry	1.48601	.88527	.624	-1.0312	4.0032
		large wax	2.93687*	.82700	.005	.6008	5.2729
		small wax	2.42761	.87772	.062	-.0670	4.9222
	cleaning	ceramic core	-3.60474*	.91135	.001	-6.1982	-1.0113
		foundry	-2.11873	.87478	.154	-4.6071	.3696
		large wax	-.66787	.81576	.994	-2.9751	1.6394
		small wax	-1.17713	.86715	.850	-3.6429	1.2887
	foundry	ceramic core	-1.48601	.88527	.624	-4.0032	1.0312
		cleaning	2.11873	.87478	.154	-.3696	4.6071
		large wax	1.45085	.78652	.490	-.7801	3.6819

		small wax	.94160	.83970	.950	-1.4480	3.3312
	large wax	ceramic core	-2.93687*	.82700	.005	-5.2729	-.6008
		cleaning	.66787	.81576	.994	-1.6394	2.9751
		foundry	-1.45085	.78652	.490	-3.6819	.7801
		small wax	-.50926	.77802	.999	-2.7177	1.6992
	small wax	ceramic core	-2.42761	.87772	.062	-4.9222	.0670
		cleaning	1.17713	.86715	.850	-1.2887	3.6429
		foundry	-.94160	.83970	.950	-3.3312	1.4480
		large wax	.50926	.77802	.999	-1.6992	2.7177
factor 3 breaking rules	ceramic core	cleaning	2.72909	1.29920	.313	-.9659	6.4241
		foundry	3.60909	1.29920	.060	-.0859	7.3041
		large wax	2.38131	1.20271	.384	-1.0156	5.7782
		small wax	.59428	1.27648	1.000	-3.0332	4.2218
	cleaning	ceramic core	-2.72909	1.29920	.313	-6.4241	.9659
		foundry	.88000	1.25706	.999	-2.6970	4.4570
		large wax	-.34778	1.15705	1.000	-3.6267	2.9311
		small wax	-2.13481	1.23356	.584	-5.6443	1.3746
	foundry	ceramic core	-3.60909	1.29920	.060	-7.3041	.0859
		cleaning	-.88000	1.25706	.999	-4.4570	2.6970
		large wax	-1.22778	1.15705	.964	-4.5067	2.0511
		small wax	-3.01481	1.23356	.146	-6.5243	.4946
	large wax	ceramic core	-2.38131	1.20271	.384	-5.7782	1.0156
		cleaning	.34778	1.15705	1.000	-2.9311	3.6267
		foundry	1.22778	1.15705	.964	-2.0511	4.5067
		small wax	-1.78704	1.13148	.699	-4.9984	1.4243
	small wax	ceramic core	-.59428	1.27648	1.000	-4.2218	3.0332
		cleaning	2.13481	1.23356	.584	-1.3746	5.6443
		foundry	3.01481	1.23356	.146	-.4946	6.5243
		large wax	1.78704	1.13148	.699	-1.4243	4.9984
factor 4 estrangement	ceramic core	cleaning	3.09636*	.96285	.016	.3580	5.8348
		foundry	2.40559	.95415	.120	-.3071	5.1183
		large wax	2.99351*	.89616	.010	.4603	5.5267
		small wax	2.28451	.94602	.156	-.4039	4.9729

	cleaning	ceramic core	-3.09636*	.96285	.016	-5.8348	-.3580
		foundry	-.69077	.92262	.997	-3.3160	1.9344
		large wax	-.10286	.86251	1.000	-2.5485	2.3428
		small wax	-.81185	.91420	.990	-3.4127	1.7890
	foundry	ceramic core	-2.40559	.95415	.120	-5.1183	.3071
		cleaning	.69077	.92262	.997	-1.9344	3.3160
		large wax	.58791	.85278	.999	-1.8320	cleaning79
		small wax	-.12108	.90503	1.000	-2.6962	2.4541
	large wax	ceramic core	-2.99351*	.89616	.010	-5.5267	-.4603
		cleaning	.10286	.86251	1.000	-2.3428	2.5485
		foundry	-.58791	.85278	.999	-cleaning79	1.8320
		small wax	-.70899	.84367	.993	-3.1046	1.6867
	small wax	ceramic core	-2.28451	.94602	.156	-4.9729	.4039
		cleaning	.81185	.91420	.990	-1.7890	3.4127
		foundry	.12108	.90503	1.000	-2.4541	2.6962
		large wax	.70899	.84367	.993	-1.6867	3.1046

Appendix E

OBSERVATIONAL CHECKLIST FOR THE ALLOY DEPARTMENT

Area: ……………………	Date/Time: ………………………………………………..	Observer: ………………………………..
Please use the space below to record any comments:		

	#SAFE	#UNSAFE	N/A	Comments
1. Operating at safe speed for conditions & obeying speed limit (3m/h – 4km/h inside; 5m/h – 8hm/h outside)				
2. Seat belts worn in vehicle				
3. Complete stop at pedestrian intersections and vehicle doors				
4. Employee is looking in direction of travel and vision is not obstructed				
5. Loads stable and properly placed on forks during transport				
6. Pedestrians not within 3 ft. (91cm) next to vehicle in operation				
7. Forks raised above 6 inches (15 cm) height when not lifting				
8. Parked vehicles: parking brake set, forks lowered				
9. Vehicle ignition turned off when unattended				
10. Not parked in walkway				
11. Suspended loads left unattended				
12. Wheel chocks on one wheel when forklift is parked outside				
13. Forklift (or other vehicle) blocking thoroughfare [inviting non certificated drivers to move it]				
14. Keys left in a truck				
15. Tractors attached to trailers are turned off with parking brakes set				
16. Drive off barriers in place on vacated docks with open doors				

% Safety Performance Level = $\left[\dfrac{TotalSafe}{TotalSafe + TotalUnsafe}\right] \cdot 100 = \left[\dfrac{\ldots\ldots\ldots\ldots}{\ldots\ldots\ldots\ldots}\right] \cdot 100 =$

%

Area: ………………………	Date/Time: ………………………………………………..	Observer: ………………………………..

Please use the space below to record any comments:

	#SAFE	#UNSAFE	N/A	Comments
1. Floors are clean & free from debris, oil & dirt.				
2. Tools & any other material is not left to sit directly on the floor.				
3. No heavy items or sharp items are placed on top of machines, cabinets & equipment.				
4. Designated walkways are clean & free from debris, oil & dirt.				
5. Designated walkways are free from obstructions or other trip hazards				
6. Nothing leans against the walls				
7. Nothing leans against the columns				
8. Nothing leans against machines				
9. Cranes' hooks are placed in the dock stations if not operating or rest safely				
10. Keys left in the crane control panel (so anyone can operate it)				

% Safety Performance Level = $\left[\dfrac{TotalSafe}{TotalSafe + TotalUnsafe}\right]\cdot 100 = \left[\dfrac{\cdots\cdots\cdots\cdots}{\cdots\cdots\cdots\cdots}\right]\cdot 100 =$ %

Area: ……………………………	Date/Time: ……………………………………..	Observer: ………………………………..

Please use the space below to record any comments:

	#SAFE	#UNSAFE	N/A	Comments
1. Gloves - appropriate specification for task – used with contact with sharp edges, hot objects, chemicals				
2. Respirators/dust mask – wearing - Breathing protection should be worn in areas where there is dust				
3. Footwear				
4. High visibility jacket				
5. Hard hat				
6. Safety glasses				
7. Ear defender (Earplugs/ earmuffs)				
8. If doing hot work (grinding, welding) – does he wear a correct PPE				

% Safety Performance Level = $\left[\dfrac{TotalSafe}{TotalSafe + TotalUnsafe}\right]\cdot 100 = \left[\dfrac{\cdots\cdots\cdots\cdots}{\cdots\cdots\cdots\cdots}\right]\cdot 100 =$ %

Below you will find a set of questions asking your opinion about health and safety at the company. Please complete the questions below about you and your job. Please try to respond to every statement and answer as honestly as possible. Do not spend more than 30 seconds on each statement. THE SURVEY IS ANONYMOUS AND NONE OF YOUR ANSWERS WILL BE PASSED TO THE COMPANY IN A FORM THAT ALLOWS INDIVIDUAL EMPLOYEES TO BE IDENTIFED.

If you have any questions or concerns regarding these questionnaires or the feedback program in general please do not hesitate to call me or speak to me. All your suggestions are very welcomed and will stay confidential.

Marcin Nazaruk

Ext. 2811

ORGANISATION-LEVEL SAFETY CLIMATE

Top management in this plant–company . . .	Strongly disagree	Disagree	Neither agree nor disagree/ neutral	Agree	Strongly agree
1. Reacts quickly to solve the problem when told about safety hazards.	1	2	3	4	5
2. Insists on thorough and regular safety audits and inspections.	1	2	3	4	5
3. Tries to continually improve safety levels in each department.	1	2	3	4	5
4. Provides all the equipment needed to do the job safely.	1	2	3	4	5
5. Is strict about working safely when work falls behind schedule.	1	2	3	4	5
6. Quickly corrects any safety hazard (even if it's costly).	1	2	3	4	5
7. Provides detailed safety reports to workers (e.g., injuries, near accidents).	1	2	3	4	5
8. Considers a person's safety behaviour when moving–promoting people.	1	2	3	4	5
9. Requires each manager to help improve safety in his– her department.	1	2	3	4	5
10. Invests a lot of time and money in safety training for workers.	1	2	3	4	5
11. Uses any available information to improve existing safety rules.	1	2	3	4	5
12. Listens carefully to workers' ideas about improving safety.	1	2	3	4	5
13. Considers safety when setting production speed and schedules.	1	2	3	4	5
14. Provides workers with a lot of information on safety issues.	1	2	3	4	5
15. Regularly holds safety-awareness events (e.g., presentations, ceremonies).	1	2	3	4	5
16. Gives safety personnel the power they need to do their job.	1	2	3	4	5

GROUP-LEVEL SAFETY CLIMATE

My direct supervisor . . .	Strongly disagree	Disagree	Neither agree nor disagree/ neutral	Agree	Strongly agree
1. Makes sure we receive all the equipment needed to do the job safely.	1	2	3	4	5
2. Frequently checks to see if we are all obeying the safety rules.	1	2	3	4	5
3. Discusses how to improve safety with us.	1	2	3	4	5
4. Uses explanations (not just compliance) to get us to act safely.	1	2	3	4	5
5. Emphasizes safety procedures when we are working under pressure.	1	2	3	4	5
6. Frequently tells us about the hazards in our work.	1	2	3	4	5

7. Refuses to ignore safety rules when work falls behind schedule.	1	2	3	4	5
8. Is strict about working safely when we are tired or stressed.	1	2	3	4	5
9. Reminds workers who need reminders to work safely.	1	2	3	4	5
10. Makes sure we follow all the safety rules (not just the most important ones).	1	2	3	4	5
11. Insists that we obey safety rules when fixing equipment or machines.	1	2	3	4	5
12. Says a "good word" to workers who pay special attention to safety.	1	2	3	4	5
13. Is strict about safety at the end of the shift, when we want to go home.	1	2	3	4	5
14. Spends time helping us learn to see problems before they arise.	1	2	3	4	5
15. Frequently talks about safety issues throughout the work week.	1	2	3	4	5
16. Insists we wear our protective equipment even if it is uncomfortable.	1	2	3	4	5

SAFETY CITIZENSHIP

We would like to know whether you feel certain activities are an expected part of your official job responsibilities or if you consider them above and beyond what is expected in your job.	Expected part of my job	Slightly beyond what is expected for my job	Moderately beyond what is expected for my job	Much beyond what is expected for my job	Definitely beyond what is expected for my job
1. Volunteering for safety committees	1	2	3	4	5
2. Helping teach safety procedures to new crew members..............................	1	2	3	4	5
3. Assisting others to make sure they perform their work safely..............................	1	2	3	4	5
4. Getting involved in safety activities to help my crew work more safely	1	2	3	4	5
5. Helping other crew members learn about safe work practices	1	2	3	4	5
6. Helping others with safety related responsibilities..............................	1	2	3	4	5
7. Making safety-related recommendations about work activities..............................	1	2	3	4	5
8. Speaking up and encouraging others to get involved in safety issues..............................	1	2	3	4	5
9. Expressing opinions on safety matters even if others disagree..............................	1	2	3	4	5
10. Raising safety concerns during planning sessions..............................	1	2	3	4	5
11. Protecting fellow crew members from safety hazards	1	2	3	4	5
12. Going out of my way to look out for the safety of other crew members..............................	1	2	3	4	5
13. Taking action to protect other crew members from risky situations..............................	1	2	3	4	5
14. Trying to prevent other crew members from being injured on the job	1	2	3	4	5
15. Taking action to stop safety violations in order to protect the well-being of other crew members	1	2	3	4	5
16. Explaining to other crew members that I will report safety violations	1	2	3	4	5
17. Telling other crew members to follow safe working procedures	1	2	3	4	5
18. Monitoring new crew members to ensure they are performing safely..............................	1	2	3	4	5
19. Reporting crew members that violate safety procedures..............................	1	2	3	4	5
20. Telling new crew members that violations of safety procedures will not be tolerated.............	1	2	3	4	5
21. Attending safety meetings..............................	1	2	3	4	5
22. Attending non-mandatory safety oriented meetings..............................	1	2	3	4	5
23. Keeping informed of changes in safety policies and procedures	1	2	3	4	5
24. Trying to improve safety procedures.............	1	2	3	4	5
25. Trying to change the way the job is done to make it safer	1	2	3	4	5
26. Trying to change policies and procedures to make them safer..............................	1	2	3	4	5
27. Making suggestions to improve the safety	1	2	3	4	5

of a job...					

LMX

Do you usually know how satisfied your supervisor is with what you do?	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
How well does your supervisor understand your job problems and needs?	Not a Bit	A Little	A Fair Amount	Quite a Bit	A Great Deal
How well does your supervisor recognize your potential?	Not at All	A Little	Moderately	Mostly	Fully
Regardless of how much formal authority he has built into his position, what are the chances that your supervisor would use his power to help you solve problems in your work?	None	Small	Moderate	High	Very High
Again, regardless of the amount of formal authority your supervisor has, what are the chances that he would “bail you out,” at his expense?	None	Small	Moderate	High	Very High
I have enough confidence in my supervisor that I would defend and justify his decision if he was not present to do so?	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
How would you characterize your working relationship with your supervisor?	Extremely ineffective	Worse than average	Average	Better than average	Extremely effective

THE FUTURE OF YOUR JOB

What is the FUTURE OF YOUR JOB with this organization like? Finish the sentence with **every** adjective from the list below and circle appropriate answer:

Future of my job in this company is….

Sure..	Yes	?	No
Unpredictable..	Yes	?	No
Up in the air..	Yes	?	No
Secure..	Yes	?	No
Stable...	Yes	?	No
Questionable...	Yes	?	No
Unknown..	Yes	?	No
Well established..	Yes	?	No
My job is almost guaranteed...............	Yes	?	No
Uncertain..	Yes	?	No
Can depend on being here.......................	Yes	?	No
Future is vague..	Yes	?	No
Unclear...	Yes	?	No
Permanent position if I want it..........	Yes	?	No
Certain..	Yes	?	No
This job might not be around too long..	Yes	?	No
Unspecified..	Yes	?	No
Insecure..	Yes	?	No

FEEDBACK – TO SUPERVISORS FROM SHOP-FLOOR WORKERS

Read each statement carefully. Indicate your answer by <u>putting a cross</u> in the appropriate box. Please respond to every statement. It is important that you answer each question honestly.

ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

1. How often did your supervisor(s) acknowledged you for working safely **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
2. How often did your supervisor(s) talk to you, **during the last 3 days,** about safety (including housekeeping)?	Never *Move to Q.4*	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
3. How often was/were your supervisor(s) polite and respectful (even if joking) when he talked to you about safety **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
4. How often did your supervisor(s) ask, **during the last 3 days,** about your opinion regarding safety issues associated with your job?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
5. How often did your supervisor(s) make sure, **during the last 3 days,** that safety rules were followed even when there was a lot of pressure to get the job done?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
6. How often did your supervisor(s) set a good example, **during the last 3 days,** by complying with safety rules?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
7. **During the last 3 days** I gave my	1. 2.	YES NO – *stop and submit the form*				

supervisor(s) an idea on how to improve safety.						
8. How often did your supervisor(s) welcome and value any suggestions you made on how to improve safety?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
9. My supervisor updated me on the progress of the reported idea within 24h.	1. YES 2. NO					
Additional comments *(all will stay confidential)* ……………………………………………………………………………… ………………………………………………………………………………						

FEEDBACK – TO SUPERVISORS FROM MANAGERS

Read each statement carefully. Indicate your answer by putting a cross in the appropriate box. Please respond to every statement. It is important that you answer each question honestly.

ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

By "my supervisor" please consider one of the following persons, accordingly to your working area: (here names of supervisors).

1. How often did the supervisors update you, **during the last 3 days,** about news and issues re safety without being asked?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
2. How often did the supervisors come up with safety ideas, **during the last 3 days,** on how to improve safety?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often

Is there anything else that you think should be taken into consideration?

Additional comments *(all will stay confidential)*
………………………………………………………………………………
………………………………………………………………………………

FEEDBACK – TO SUPERVISORS FROM PEERS

Read each statement carefully. Indicate your answer by putting a cross in the appropriate box. Please respond to every statement. It is important that you answer each question honestly.

ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

By "other supervisor" please consider one of the following persons, accordingly to your working area: (here names of supervisors).

1. How often did other supervisors share safety information with you **during the last 3 days**?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
2. How often, **during the last 3 days**, did you and other supervisors discuss how to solve encountered safety problems?	Never *Move to Q.4.*	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
3. How often did other supervisors show respect for other people's opinion when you discussed safety together, **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
4. How often did other supervisors offer you help whenever you asked for it, **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often

Is there anything else that you think should be taken into consideration?

Additional comments *(all will stay confidential)*
……………………………………………………………………………………
……………………………………………………………………………………

FEEDBACK – TO MANAGER FROM SHOP-FLOOR WORKERS

Read each statement carefully. Indicate your answer by putting a cross in the appropriate box. Please respond to every statement. It is important that you answer each question honestly.

ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

1. How often did your manager(s) acknowledged you for working safely **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
2. How often did your manager(s) talk to you **during the last 3 days** about safety?	Never *Move to Q.4*	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
3. How often was/were your manager(s) polite and respectful (even if joking) when he talked to you about safety **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
4. How often did your manager(s) ask **during the last 3 days** about your opinion regarding safety issues associated with your job?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
5. How often was/were your manager(s) strict, **during the last 3 days,** about working safely when work fell behind schedule?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
6. **During the last 3 days** I gave my manager(s) an idea on how to improve safety	1. YES 2. NO – *stop and submit the form*					
7. How often did your manager(s) welcome and value any suggestions you made on how to improve safety	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often

8. My manager(s) updated me on the progress of the reported idea within 24h	1. YES 2. NO						
9. My manager(s) acted decisively when I raised a safety concern	1. YES 2. NO						

Additional comments *(all will stay confidential)*
………………………………………………………………………………
………………………………………………………………………………

FEEDBACK – TO MANAGERS FROM SUPERVISORS

Read each statement carefully. Indicate your answer by <u>putting a cross</u> in the appropriate box. Please respond to every statement. It is important that you answer each question honestly.

ALL INFORMATION WILL BE TREATED WITH THE STRICTEST CONFIDENCE.

By "my manager" please consider one of the following persons, accordingly to your working area: (here names of managers)

1. **During the last 3 days** I gave my manager(s) an idea on how to improve safety	1. YES 2. NO		*– Move to Q.5*			
2. How often did your manager(s) welcome and value any suggestions you made on how to improve safety, **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
3. How often did your manager discuss with you, **during the last 3 days**, what is the best solution for the raised safety problems?	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
4. How often did your manager(s) act decisively when you raised a safety concern **during the last 3 days?**	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often
5. How often did your manager(s) clearly communicate his/their expectations towards	Never	Rarely	Occasionally	Sometimes	Fairly Often	Very Often

your performance re safety, **during the last 3 days?**	
Is there anything else that you think should be taken into consideration?	
Additional comments *(all will stay confidential)* ………………………………………………………………………………………… ……………………………………………………………………………………	

PROMPTS FOR INTERVIEWS WITH INTERVENTION PARTICIPANTS

Interviews with supervisors:

Reminder: 360-degree feedback, feedback from different groups of employees regarding behaviours that support safety.

1. What did supervisors think when I tried to present the idea
   a. what were the strengths and weaknesses of the idea;
   b. what the biggest obstacle for supervisors to engage in the program;
   c. what did the supervisors think about the potential effectiveness of the program;
   d. what was the biggest obstacle for supervisors to modify their behaviour;
2. Why do you think employees refused to fill out the feedback forms?

Interviews with operatives:

Reminder: 360-degree feedback, feedback from different groups of employees re behaviours that support safety.

1. What did your colleagues think when I tried to present the idea
   a. what were the strengths and weaknesses of the idea;
   b. what the biggest obstacle for your mates to engage in the program;
   c. what did your co-workers think about the potential effectiveness of the program;
   d. what was the biggest obstacle for shop-floor employees to fill out the forms;

INTRODUCTION OF EXPERTS (QUOTES FROM SELF INTRODUCTION)

Bill Sims – the CEO of Bill Sims Company, U.S.A.

By 1983 I had done a quality improvement process for Coca-Cola nationally throughout their whole facilities in the U.S.A. I have done work for North Railroad, Du-Pont, General Motors, Ford, Chrysler, Golf Stream Aerospace, McDonalds and our approach has been originally through the door of developing incentive systems and recognition systems, and some of the early efforts were product-driven. We quickly learned that social reinforcers could be paired with the tangible reinforcers, and we learned that coupling the social reinforcement with the tangible was extremely powerful if done the right way, so that is our entry now. We are a full-blown behaviour-based company offering behaviour-based solutions around the world that sometimes include the use of gift items as tangible reinforcers – it just depends on what that company needs.

Ken Lucas – Director of Hasmsl, UK

I started my career with Mars UK. I was responsible for site maintenance and infrastructure. I ended up being the Mars H&S and environment manager. I retired from them in 2002 and joined IOSH as a technical and sales manager for a couple of years and then started my own business. In terms of H&S experience I travelled the world a lot with Mars because they are a global corporation so I learned a great deal.

Kate Blackford – former consultant for Ryder MARSH International

Experienced in implementing behavioural interventions in a variety of industries: I have done work with paper manufacturers, construction companies, food production, can making and metals.

Mark Taylor[28]

I am a chartered industrial and occupational psychologist recognised by the BPS. I am also a registered economist and associate of the International Institute of Risk and Safety Management. I have been working in the field of behaviour-based safety for the past 15 years working for a number of consultancies including applied

[28] Did not agree to disclose his position or the name of the company.

behavioural scientists, and Ryder MARSH as the cooperation director. I was an associate director in charge of behavioural risk, currently moving positions to take charge of Health & Safety security and environment.

<u>Prof. Andrew Hale – Chairman of 'Hastam'</u>

"Andrew was a founder member of the Aston University Department of Safety & Hygiene, where he worked from 1972-1984. While at Aston he developed the first MSc course in Safety & Hygiene and was one of the initiators of NEBOSH. From 1984 to 2009 he was Professor of Safety Science at the Delft University of Technology in the Netherlands, developing and running a multidisciplinary group of researchers and lecturers, working in all branches of safety, from occupational and construction to transport, home and leisure. This work included developing the first university Masters courses for safety in the Netherlands. His group in Delft won the president's medal of the Ergonomics Society in 2000. He continues to supervise PhD students at Delft.

He is a chartered psychologist and registered member of the Ergonomics Society. He is a chartered fellow of IOSH and was given its Distinguished Service Award in 1987. In 2007 he received a similar award for his services to its Dutch equivalent NVVK, as well as the Distinguished Service Award of RoSPA for his contribution to the subject area throughout his career."[29]

<u>Dr Shelly Jeffcot – Senior Research Fellow in the NHMRC Centre for Research Excellence in Patient Safety (CRE-PS). University of Melbourne, Australia</u>

I work at the Centre of Research Excellence in H&S at the University in Melbourne. My background is in psychology and looking at safety critical systems that have predominantly been health care but also in the rail sector in the UK. Most of the work that I have done has been survey based or interview and focus groups. I have quite a wide knowledge of the literature around safety culture and the different interventions.

[29] http://www.hastam.co.uk/personnel/arh.htm

Dr Kathryn Mearns – Senior lecturer at the University of Aberdeen

Since the early 1990s I have been involved in developing measurement instruments for safety culture and/or safety climate with the offshore industry and building on work conducted by recent psychologist Conrad Rundmo looking at risk perception in offshore workers and then moving on to looking at safety attitudes, perception of safety, safety satisfaction, risk perception, issues to do with perception of management commitment to safety and supervisors' commitment to safety. More recently I have been involved in work looking at safety culture throughout the European countries and that's pretty much Europe-wide, and I started that work about four years ago again trying to develop an instrument that measured I guess a wider range of factors than a safety climate questionnaire would.

Alistair Schofield - managing director of leadership and management experts Extensor Ltd.

"Alistair had used training and development programmes to lay the foundations for change within the organisations he had worked for. However, his disillusionment with the training industry had led him to develop and lead his own programmes that were intrinsically linked to the business goals. It is on the basis of this experience that Alistair established Extensor."[30]

Conrad Pots

"I worked for the United Nations, went overseas for seven years, based in the South Pacific, setting up management training centres and psychological centres. My discipline was psychology as well as business, basically came out to work for very large organisations and set off my own consultancy about 20-25 years ago. I worked with most of the top 1000 companies in the UK, done a lot of work with them overseas, worked for a number of business schools like Imperial College, did leadership, team building and a lot of executive coaching"

Phil Hayes – leadership coach working for Management Futures

"I have been working in the field of leadership development and coaching for about 20 years or so – a little bit more - and currently I am executive director of

[30] http://www.extensor.co.uk/programme_leaders.html

Management Futures Ltd. which is a company that specialise in coaching, coach training and leadership development activities; as part of that I had a career in social services as a social worker."

Chris Henderson - Principal and founder of Leadership Connections Ltd.

"I have spent most of my career working for companies large part working for Boots and Barclays, but half my career I spent as a director of HR, about half I spent as a director in a number of other functions, including property, operations, strategy and others. About 4-5 years ago I set up my own consultancy business and now do a variety of work, most of it around leadership development in a variety of forms, one-to-one coaching, development programs and others."

Lorraine Calland – Founder and Director of 'Passion at Work'

I was involved in production, marketing, sales, customer service and logistics and in most of these areas I had some kind of management role, so my kind of direct experience is managing and leading teams, but I moved in 1989 - I actually went freelance as a training and development consultant and I have been involved in a business since then. We have been involved in some huge projects that involved culture change, some of which lasted, in fact one of them lasted for about 10 years, so some of the work we have done has been very big and other projects were quite small so there is a real mix of experience that we have, but it's a long experience.

John Nevitt – Chair of the IOSH Food and Drink Group, Group Health and Safety manager for Tulip UK - a multinational food manufacturing company.

"In the UK we have 19 operational sites and distribution plants. We currently employ about 8500 employees in the UK. My responsibility is the production of policy and strategy across UK and liaison with the Danish head office. I am also an adviser to the British Meat Processes Association and a member of the European H&S agency - one of the specialist councils where I act as an adviser."

Robin Phillips

"I was a full-time researcher working for the University of Manchester, Institute of Science and Technology. My area of expertise and research was behavioural applied safety in the area of safety in the construction sector. I left

Manchester and joined Marsh Risk Consulting, part of Marsh McLenon, as the European leader, again behaviour-based safety and now I work for the Mace Lee construction firm, again delivering behaviour-based safety, another H&S sort of program.

Paul Mahoney – working in a group of H&S advisers for food company.[31]

Tom Chamber – Safety, Health and Environmental manager for the Greencore Group.

"I have been directly employed in SH&E management for 20 years. I am a Chartered member of the Institute of Occupational Safety & Health. I am the current Vice Chair of the IOSH Group Management Committee and the Immediate Past Chair of the IOSH Food & Drinks Group. I also currently represent the Chilled Foods Association at the Food Manufacturing Forum."

[31] Did not agree to provide more details.

Appendix F

SAFETY ELEMENTS OF THE STANDARDISED WORK FOR LEADERS

	YES	NO	ACTIONS TAKEN
Did you observe that everyone in the department is obeying safety rules	YES	NO	
Did you interact with an operator to share any of his/her ideas to improve safety	YES	NO	
Did you check with an operator if he noticed any environment issue that can potentially harm his workmate	YES	NO	
Did you educate an operator about the hazard related to the work being performed	YES	NO	
Did you recognize an operator for performing the task to the safety standards	YES	NO	
Did you remind an operator on any of the safety rules	YES	NO	
Did you check with an operator if he came close to injuring himself recently	YES	NO	

OBSERVATIONAL CHECKLIST FOR CLEANING DEPARTMENT

Area: Cleaning	Date/Time:………………………………	Observer:………………		
		#SAFE	#UNSAFE	N/A
Mobile equipment - on the move				
1. Operating at safe speed for conditions & obeying speed limit (3m/h – 4km/h inside; 5m/h – 8hm/h outside)				
2. Employee is looking in direction of travel and vision is not obstructed				
3. Loads stable and properly placed on forks during transport				
4. Pedestrians not within 3 ft. (91cm) next to vehicle in operation				
Mobile equipment - parked				
5. Not parked in walkway				
6. Wheel chocks on one wheel when forklift is parked outside				
7. Keys left in a truck				
Walkways				
11. Tools/castings/rubbish/trolleys/stillages or anything else left in the walkways				
12. Congested walkways with work/traffic				

Storage - Stillages			
8. Fixtures or other things put on the top of stillages			
9. Stacked unsafely or over head height level			
10. Fixtures or other sharp pieces protrude over the edge of stillage			
11. Left in the work-traffic area			
Storage - Trolleys			
12. A fixture or other piece may fall from a trolley (too many on or protrudes over the edge)			
13. Trolleys are left in the work place traffic areas			
14. Plastic boxes stacked unevenly			
Tools/castings/rubbish or anything else			
13. Left on the floor in working area (creates a trip hazard)			
14. Left up against walls or machines			
Blocked access – tools/castings, rubbish or anything else			
15. Machines			
16. Fire extinguishers			
17. Fire exit/ the shortest emergency path			
Behaviour PPE			
18. Proper PPE set is being worn (gloves, footwear, highvis jacket, safety glasses, earplugs)			
Behaviour – manual handling			
19. If a person is carrying sth - heavier than 10 kilo			
20. If a person is picking sth up - from below the knees height improperly			
Hoists			
9. A hook or chain does not rest safely (incl. Hanging in the walkway)			
Space			
10. Congested work areas with people/stock			
Totals			

% Safety Performance Level =

$$\left[\frac{TotalSafe}{TotalSafe + TotalUnsafe}\right]\cdot 100 = \left[\frac{\dots\dots\dots\dots}{\dots\dots\dots\dots}\right]\cdot 100 = \qquad \%$$

Table F1. Mauchly's test gauging the assumption of sphericity (Finishing department)

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Month	.013	26.651	14	.030	.524	.801	.200

Table F2. Significance of differences between months corrected with Greenhouse-Geisser (Finishing department)

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Month	Sphericity Assumed	710.744	5	142.149	3.624	.008
	Greenhouse-Geisser	710.744	2.618	271.511	3.624	.035
	Huynh-Feldt	710.744	4.006	177.435	3.624	.015
	Lower-bound	710.744	1.000	710.744	3.624	.093
Error(Month)	Sphericity Assumed	1568.824	40	39.221		
	Greenhouse-Geisser	1568.824	20.942	74.913		
	Huynh-Feldt	1568.824	32.045	48.956		
	Lower-bound	1568.824	8.000	196.103		

Table F3. Results of application of simple contrast to calculate differences between the first month and the following months (Finishing department)

Source	Month	Type III Sum of Squares	df	Mean Square	F	Sig.
Month	Month 2 vs. Month 1	481.071	1	481.071	5.554	.046
	Month 3 vs. Month 1	829.440	1	829.440	18.877	.002
	Month 4 vs. Month 1	942.490	1	942.490	7.042	.029
	Month 5 vs. Month 1	839.068	1	839.068	28.583	.001
	Month 6 vs. Month 1	918.090	1	918.090	7.688	.024
Error(month)	Month 2 vs. Month 1	692.889	8	86.611		
	Month 3 vs. Month 1	351.520	8	43.940		
	Month 4 vs. Month 1	1070.640	8	133.830		
	Month 5 vs. Month 1	234.842	8	29.355		
	Month 6 vs. Month 1	955.400	8	119.425		

Table F4. Results of application of repeated contrasts (Finishing department)

Source	Month	Type III Sum of Squares	df	Mean Square	F	Sig.
Month	Month 1 vs. Month 2	481.071	1	481.071	5.554	.046
	Month 2 vs. Month 3	47.151	1	47.151	.324	.585
	Month 3 vs. Month 4	3.610	1	3.610	.035	.855
	Month 4 vs. Month 5	3.004	1	3.004	.046	.836
	Month 5 vs. Month 6	1.778	1	1.778	.031	.865
Error(month)	Month 1 vs. Month 2	692.889	8	86.611		
	Month 2 vs. Month 3	1165.049	8	145.631		
	Month 3 vs. Month 4	815.220	8	101.903		
	Month 4 vs. Month 5	527.236	8	65.904		
	Month 5 vs. Month 6	462.162	8	57.770		

Table F5. Mauchly’s test gauging the assumption of sphericity (EDM department)

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
month	.074	15.872	14	.358	.521	.796	.200

Table F6. Significance of differences between months corrected with greenhouse-Geisser (EDM department)

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
month	Sphericity Assumed	92.588	5	18.518	1.597	.183
	Greenhouse-Geisser	92.588	2.607	35.511	1.597	.223
	Huynh-Feldt	92.588	3.981	23.260	1.597	.199
	Lower-bound	92.588	1.000	92.588	1.597	.242
Error(month)	Sphericity Assumed	463.733	40	11.593		
	Greenhouse-Geisser	463.733	20.859	22.232		
	Huynh-Feldt	463.733	31.844	14.562		
	Lower-bound	463.733	8.000	57.967		

Table F7. The significance values for the Kolmogorov-Smirnov test:

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Organisation-level safety climate	.076	74	.200[*]
Group-level safety climate	.066	74	.200[*]
Job security	.187	74	.000
LMX	.118	74	.013
Safety citizenship	.130	74	.003

Table F8. The results of the correlation procedure.

			Organisation-level safety climate	Group-level safety climate	Job security	LMX	Safety citizenship
Kendall's tau_b	Organisation-level safety climate	Correlation Coefficient	1.000	.550[**]	.150	.249[**]	-.046
		Sig. (2-tailed)	.	.000	.058	.001	.525
		N	100	100	80	96	91
	Group-level safety climate	Correlation Coefficient	.550[**]	1.000	.339[**]	.368[**]	.005
		Sig. (2-tailed)	.000	.	.000	.000	.943
		N	100	101	81	97	91
	Job security	Correlation Coefficient	.150	.339[**]	1.000	.233[**]	.016
		Sig. (2-tailed)	.058	.000	.	.004	.843
		N	80	81	81	79	76
	LMX	Correlation Coefficient	.249[**]	.368[**]	.233[**]	1.000	.005
		Sig. (2-tailed)	.001	.000	.004	.	.949
		N	96	97	79	97	89
	Safety citizenship	Correlation Coefficient	-.046	.005	.016	.005	1.000
		Sig. (2-tailed)	.525	.943	.843	.949	.
		N	91	91	76	89	91

Table F9. Simple regression analysis – does ‘Job security’ predict the strength of ‘Group-level safety climate’

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.525[a]	.276	.267	8.31557

Table F10. Analysis of variance (job security vs group level safety climate)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2080.394	1	2080.394	30.086	.000[a]
	Residual	5462.742	79	69.149		
	Total	7543.136	80			

Table F11. Simple regression analysis – does ‘Job security’ predict the strength of ‘LMX’

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.402[a]	.162	.151	5.06124

Table F12. Analysis of variance (job security vs LMX)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	381.079	1	381.079	14.877	.000[a]
	Residual	1972.440	77	25.616		
	Total	2353.519	78			

Table F13. Simple regression analysis – does ‘Job security’ predict the strength of ‘Organisation – Level Safety Climate’

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.314[a]	.099	.087	8.76724

Table F14. Analysis of variance (job security vs. ‘Organisation – Level Safety Climate’)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	655.552	1	655.552	8.529	.005[a]
	Residual	5995.436	78	76.865		
	Total	6650.988	79			

Table F15. Analysis of variance (job security vs. ‘safety citizenship’)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	409.550	1	409.550	.754	.388[a]
	Residual	40176.239	74	542.922		
	Total	40585.789	75			

Table F16. Results of two-way ANOVA analysis for the cleaning department (experimental group) and EDM department (control group).

Measured variables	Cleaning – experimental group				EDM – control group			
Group level safety climate	Pre-test, N=41		Post-test, N=24		Pre-test, N=18		Post-test, N=18	
	M=50.87	SD=10.0	M=46.75	SD=10.3	M=50.11	SD=7.1	M=50.05	SD=8.0
	Source		Type IV Sum of Squares		df	Mean Square	F	Sig.
	Pre-test / Post-test		98.791		1	98.791	1.131	.290
	Department		36.376		1	36.376	.416	.520
	Pre / Post vs. Department		93.613		1	93.613	1.072	.303
Organisation level safety climate	Pre-test, N=41		Post-test, N=24		Pre-test, N=17		Post-test, N=18	
	M=51.07	SD=10.2	M=46.37	SD=10.5	M=52.76	SD=5.3	M=51.94	SD=6.7
	Source		Type IV Sum of Squares		df	Mean Square	F	Sig.
	Pre-test / Post-test		168.775		1	168.775	2.021	.158
	Department		292.191		1	292.191	3.498	.064
	Pre / Post vs. Department		83.344		1	83.344	.998	.320
Job security	Pre-test, N=35		Post-test, N=18		Pre-test, N=12		Post-test, N=16	
	M=14.85	SD=13.7	M=10.11	SD=12.6	M=10.5	SD=8.6	M=6.18	SD=6.7
	Source		Type IV Sum of Squares		df	Mean Square	F	Sig.
	Pre-test Post-test		356.831		1	356.831	2.583	.112
	Department		298.186		1	298.186	2.159	.146
	Pre / Post vs. Department		.817		1	.817	.006	.939
Leader-member exchange	Pre-test, N=41		Post-test, N=21		Pre-test, N=17		Post-test, N=18	
	M=19.24	SD=5.6	M=20.42	SD=6.8	M=18.76	SD=5.2	M=21.16	SD=4.4
	Source		Type IV Sum of Squares		df	Mean Square	F	Sig.
	Pre-test Post-test		69.017		1	69.017	2.158	.145
	Department		.360		1	.360	.011	.916
	Pre / Post vs. Department		7.950		1	7.950	.249	.619
Safety citizenship	Pre-test, N=36		Post-test, N=21		Pre-test, N=16		Post-test, N=18	
	M=69.47	SD=22.3	M=54	SD=24.8	M=54.43	SD=26.6	M=46.16	SD=13.1
	Source		Type IV Sum of Squares		df	Mean Square	F	Sig.
	Pre-test Post-test		2914.064		1	2914.064	5.852	.018
	Department		2703.239		1	2703.239	5.429	.022
	Pre / Post vs. Department		268.076		1	268.076	.538	.465